INSTRUCTION MANUAL

Type 1561-R Precision Sound-Level Meter

(RACKMOUNT)

A

GENERAL RADIO

MP MASTER
MA33883

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Handbook of Noise Measurement

This 260-page book, by Dr. A. P. G. Peterson and Ervin E. Gross, Jr., of the General Radio Engineering Staff, covers thoroughly the subject of noise and vibration measurement. Copies are available from General Radio at $1.00 each, postpaid in the United States and Canada.

Type 1561-R Precision Sound-Level Meter

(RACKMOUNT)

A

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CONDENSED OPERATING INSTRUCTIONS

If necessary, perform the electrical calibration as follows:

a. Turn instrument on by turning power function switch to either LINE or BATTERY POWER (batteries optional).

b. Set WEIGHTING switch to CAL, and DECIBELS controls to line up dots with CAL dot.

c. Check that MICROPHONE SENSITIVITY LEVEL dial is set to sensitivity figure for microphone being used (paragraph 2.7).

d. Adjust panel CAL and/or interior GAIN controls to give meter reading near center of CAL area.

To use the Sound-Level Meter:

a. Turn DECIBELS dial and knob fully clockwise. Set WEIGHTING switch on FLAT. If meter reads above +10, adjust large dial to give on-scale reading.

b. Select desired weighting. Adjust only DECIBELS small knob for meter indication.

c. Sound level in dB is algebraic sum of readings of DECIBELS controls and meter.

SPECIFICATIONS

Sound-Level Range (rms, dB, re 20 $\mu N/m^2$):

Frequency Characteristic	With 1560-P7 Microphone and 10-ft cable	With 1560-P7 Microphone and 1560-P40 Preamplifier*
FLAT	35 to 150 dB	31 to 130 dB
C Weighting	32 to 150 dB	27 to 130 dB
B Weighting	31 to 150 dB	26 to 130 dB
A Weighting	31 to 150 dB	27 to 130 dB

*Min obtained with x10 preamp gain, max with x1.

Allowance is made for a peak-to-rms ratio of 14 dB. When a sine-wave signal is applied to the 1560-P40, the range can be extended to 141 dB. The signal-to-noise ratio is at least 5 dB for the lower values given above.

Frequency Characteristics: Four response characteristics, A, B, C, or FLAT, as selected by a panel switch. Jacks are provided for insertion of an external filter. The A-, B-, and C-weighting characteristics are in accordance with USA Standard S1.4-1961 and IEC Publication 123, (1961,) for general-purpose sound-level meters and with IEC Publication 179, (1965,) for precision sound-level meters. Frequency response for the FLAT position is flat from 20 Hz to 20 kHz to permit measurement of sound-pressure level.

Recommended Microphone: At low sound levels, use of the Type 1560-P40 Preamplifier is recommended. The Sound-Level Meter supplies power to the Preamplifier through the connecting cable. At high sound levels the Type 1560-P7 Microphone can be used directly with a 25-foot connecting cable (Type 1560-P73). The Sound-Level Meter gain may be increased to compensate for the loss caused by the capacitance of the connecting cable.

Sound-Level Indication: Sound level is indicated by the sum of the meter and attenuator reading. The clearly marked, open-scale meter covers a span of 16 dB, with calibration from -6 to +10 dB. The attenuator is calibrated in 10 dB steps from 30 to 140 dB above 20 $\mu N/m^2$.

Output: 1.25 V behind 5500 Ω (panel meter at full scale). The output can be used to drive analyzers, recorders, oscilloscopes, or headphones. Harmonic distortion (panel meter at full scale) is less than 0.5%.

Input Impedance: Greater than 100 MΩ in parallel with 90 pF.

Meter: Rms response, and fast and slow meter speeds in accordance with USAS S1.4 - 1961 and IEC 123, (1961), for general-purpose sound-level meters and IEC 179, (1965), for precision sound-level meters.

Calibration: There are panel and internal adjustments for standardizing amplifier gain with an internal calibration circuit. The calibration circuit has a panel adjustment to permit calibration in terms of microphone sensitivity when the microphone is used with Type 1560-P40 Preamplifier. When the microphone is used directly with an extension cable, calibration should be standardized with the Type 1562 Sound-Level Calibrator or the Type 1559-B Microphone Reciprocity Calibrator. These two instruments are also recommended for making periodic over-all acoustic checks.

Temperature and Humidity: When standardized by its internal calibration system or by a Type 1562 Sound-Level Calibrator, the instrument will operate within catalog specifications (for panel-meter indications above 0 dB) over the temperature range of 10 to 50° C and the relative humidity range of 0 to 90%.

Magnetic Fields: When exposed to a 60-Hz, 1- oersted (80 a/m) magnetic field and oriented for maximum sensitivity to the field, the sound-level meter will indicate about 42 dB (C weighting).

Power Supply: 100 to 125 or 200 to 250 V, 50-60 Hz, 2.5 W. Optional nickel-cadmium batteries are available. A charging circuit for the batteries is provided. The batteries will operate the instrument for 20 to 24 hours and can be recharged in 14 to 16 hours.

DESCRIPTION	HEIGHT		WIDTH		DEPTH		NET WEIGHT		SHIPPING WEIGHT	
	in.	mm	in.	mm	in.	mm	lb	kg	lb	kg
1561-R PRECISION SOUND-LEVEL METER	3 15/32	88	19	483	14 13/16	376	15	7.0	23	10.5

Introduction—Section 1

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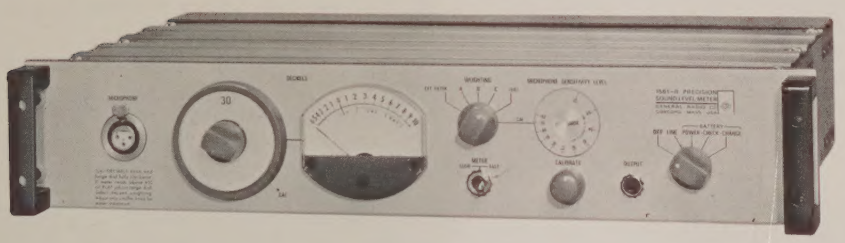

Figure 1-1. Type 1561-R Precision Sound-Level Meter.

NOTE

Users of the portable Type 1561 Precision Sound-Level Meter should refer to the Instruction Manual for the portable model.

1.1 PURPOSE.

The basic instrument of the General Radio sound-measuring system is the sound-level meter. The Type 1561-R Precision Sound-Level Meter (Figure 1-1) conforms to all requirements of the USA Standard S1.4-1961 for General Purpose Sound-Level Meters and of IEC Publication 179 (1965) for Precision Sound-Level Meters, when used with both the instrument and the observer located far enough from the microphone so that the sound field is not changed by their presence.

After it has been calibrated with the microphone with which it is to be used, the sound-level meter can be used to make precision measurements of the sound level at its microphone, over the range of 31 to 150 dB above the standard reference level of 20 $\mu N/m^2$ (0.0002 μbar). If a 1560-P40 Preamplifier is used at the microphone, the sound level can be measured down to 26 dB re 20 $\mu N/m^2$. (The signal-to-noise ratio is at least 5 dB for the low sound levels.)

In addition to its primary use as a sound-level meter, the Type 1561 can be used as a highly sensitive ac voltmeter. With the gain adjusted for a microphone sensitivity of -58 dB re 1V/μbar and the attenuator switch set to 30, the meter has a full-scale sensitivity of 25 μV. Voltages to be measured can be applied to the microphone connector.

1.2 DESCRIPTION.

1.2.1 General.

The major components of this sound-level meter are: a calibrated attenuator, an amplifier, an rms indicating meter, and weighting networks to modify the amplifier frequency response.

1.2.2 Recommended Microphone.

The Type 1560-P7 Precision Microphone (Figure 1-2) is recommended for use with the Type 1561-R Precision Sound-Level Meter. It includes a lead-zirconate-titanate piezoelectric ceramic microphone cartridge developed expressly for use with precision sound-level meters.

The Microphone:

1. Has a frequency characteristic (see Figures 1-3, 1-4 and 1-5) that is carefully controlled in manufacture to give a flat response to sound waves of random incidence at frequencies from 20 Hz to 12.5 kHz.

2. Will not be damaged by temperatures from -40° to +60°C and relative humidities of 0 to 100%.

3. Has a temperature coefficient of sensitivity of approximately -.01 dB/°C.

The internal impedance of the microphone is capacitive and is nominally 385 pF at 25° C, with a temperature coefficient of 2.2 pF/°C over the range of 0 to 50°C.

Figure 1-2. Type 1560-P7 Precision Microphone and 10-foot extension cable, P/N 1560-2500.

1.2.3 Controls, Connectors, and Indicators.

The controls, connectors, and indicators on the front and rear panels of the Type 1561-R are listed in Tables 1-1 and 1-2, respectively.

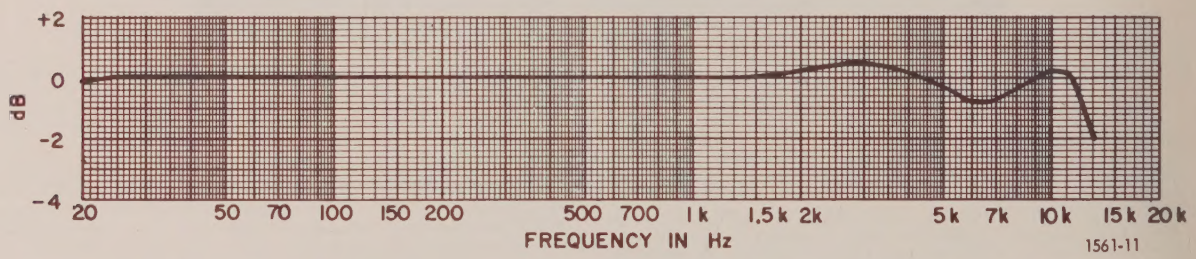

Figure 1-3. Typical random response of the 1560-P7 Precision Microphone.

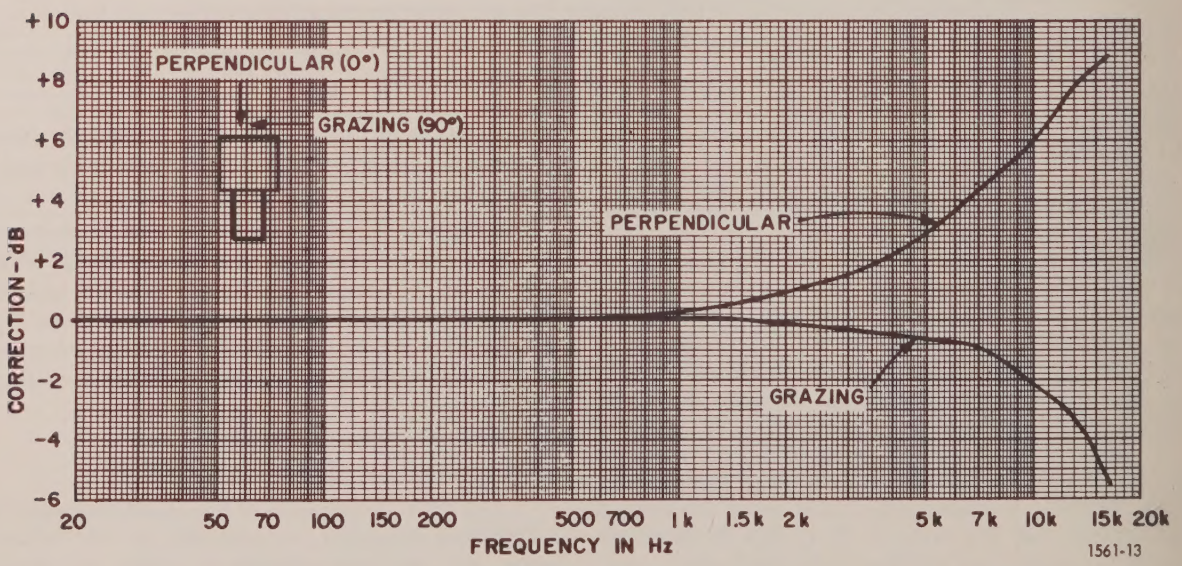

Figure 1-4. Corrections to be added to the free-field random response to obtain the perpendicular or grazing incidence response.

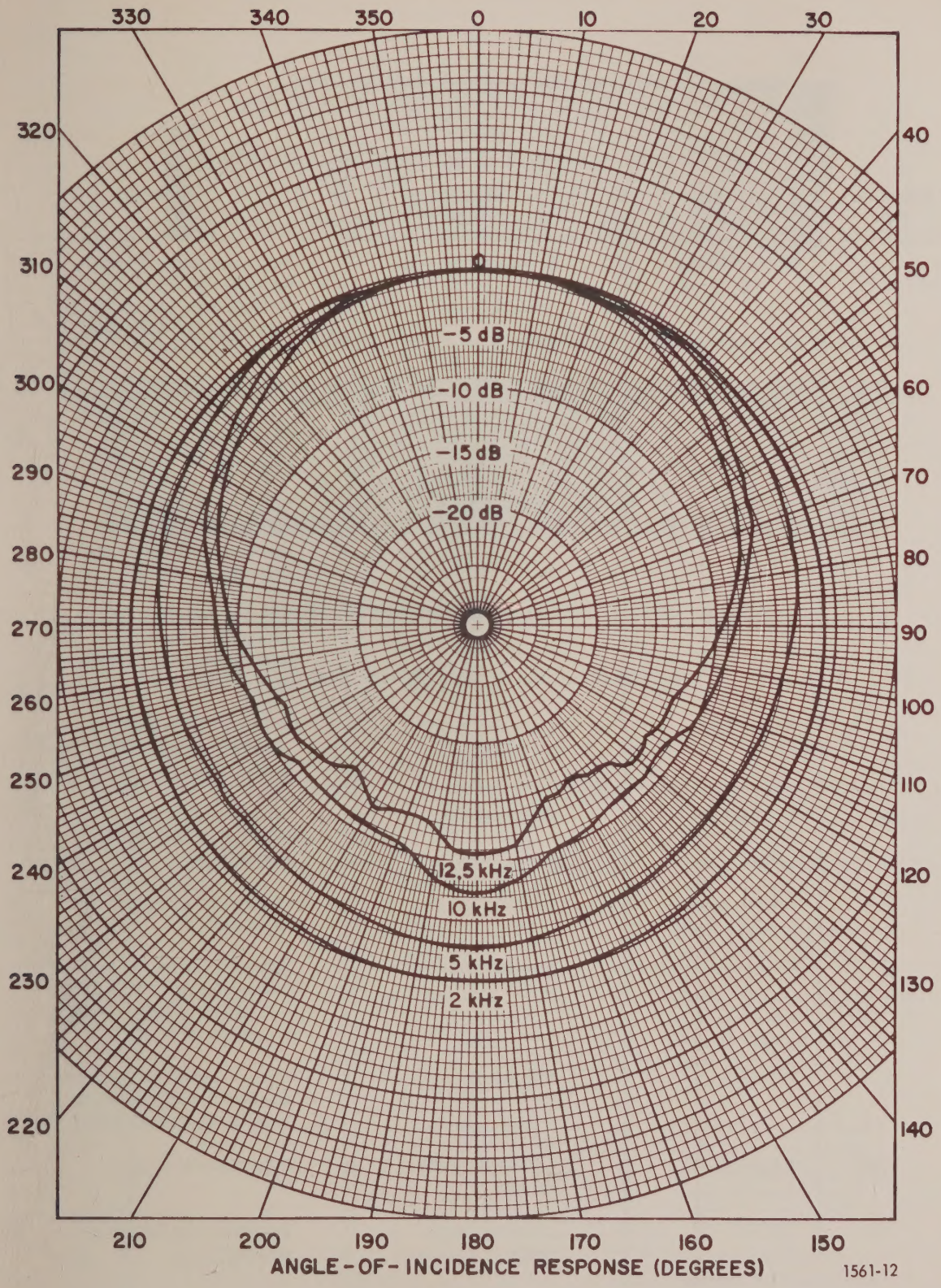

Figure 1-5. Polar plot of the angle-of-incidence response of the 1560-P7 Precision Microphone.

Table 1-1

FRONT-PANEL CONTROLS, CONNECTORS AND INDICATORS

Figure 1-6 Ref.	Name	Type	Function
1	MICROPHONE	3-terminal connector	Input connection. Power for 1560-P40 Preamplifier available here. Accepts Cannon XLR-3-12C (male) Audio Connector.
2	DECIBELS (large dial)	5-position switch	Adjusts input to preamplifier; indicates dB to be added to meter reading to obtain sound level.
3	DECIBELS (inner knob)	8-position switch	Adjusts amplifier gain; indicates dB to be added to meter reading to obtain sound level.
4	DECIBELS	Meter	Together with DECIBEL switches, indicates sound level; also indicates voltage level of battery.
5	WEIGHTING	6-position switch	Selects EXT FILTER jacks, weighting circuit, or calibrating circuit.
6	MICROPHONE SENSITIVITY LEVEL	Calibrated dial	Sensitivity setting for electrical calibration of amplifier gain.
7	————	GR Tab	"Power on" indicator (pilot light).
8	————	5-position function switch	Selects power source; also selects BATTERY CHECK or CHARGE circuit. Turns line power on or off.
9	OUTPUT	Phone jack	Output connection. Accepts standard phone plugs, such as Switchcraft, Type 440.
10	CALIBRATE	Continuous knob control	Adjusts amplifier gain.
11	METER	2-position toggle switch	Selects slow or fast meter response.

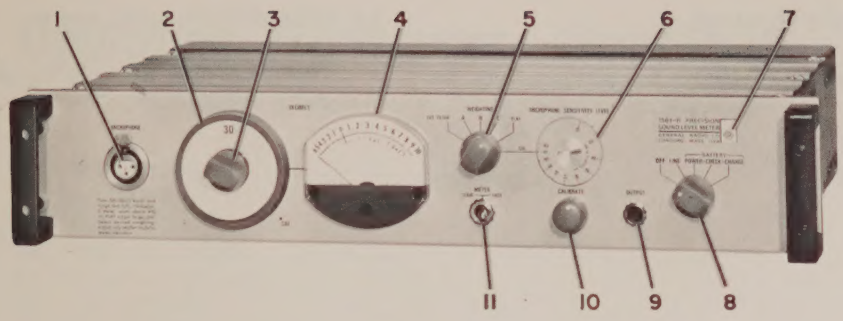

Figure 1-6. Controls, connectors, and indicators on the front panel of the Sound-Level Meter.

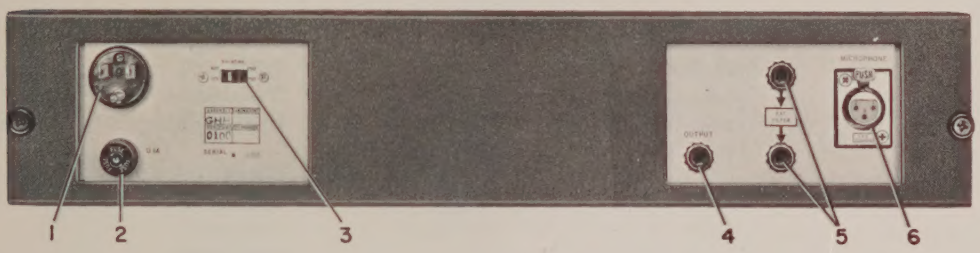

Figure 1-7. Controls and connectors on the rear panel of the Sound-Level Meter.

Table 1-2

REAR-PANEL CONTROLS AND CONNECTORS.

Figure 1-7 Ref.	Name	Type	Function
1		3-terminal plug	Line-power input connection.
2	FUSE 0.1 A	Extraction-post fuse holder	Holds 0.1-A line fuse (S10-B10).
3		2-position slide switch	Selects proper connection for 115-V or 230-V power line.
4	OUTPUT	Phone jack	Output connection, in parallel with front-panel OUTPUT jack. Accepts standard phone plugs, such as Switchcraft, Type 440.
5	EXT FILTER	Two phone jacks	Connections to and from external filter as marked on panel. Accepts standard phone plugs, such as Switchcraft, Type 440.
6	MICROPHONE	3-terminal connector	Input connection. Power for 1560-P40 Preamplifier available here. Accepts Cannon XLR-3-12C (male) Audio Connector.

1.3 ACCESSORIES SUPPLIED.

The following accessories are supplied with the 1561-R:

1 - 3-wire Power Cord	P/N 4200-9622
2 - Slo-Blo Fuses, 0.1 A	P/N 5330-0400
1 - Hardware Set	P/N 4174-2000

1.4 ACCESSORIES AVAILABLE.

The accessories available for use with the 1561-R are listed in Table 1-3.

Table 1-3
ACCESSORIES AVAILABLE

Item	GR Part Number
Type 1560-P7 Precision Microphone	1560-9607
Type 1560-P40 Preamplifier	1560-9640
10-foot Microphone Cable	1560-2500
*Type 1560-P73 25-foot Microphone Cable	1560-9673
*Type 1560-P73B 100-foot Microphone Cable	1560-9982
**Type 1560-P72 25-foot Cable	1560-9672
**Type 1560-P72B 100-foot Cable	1560-9977
**Type 1560-P72C 4-foot Cable	1560-9565
Rechargeable Batteries (Burgess Type CD-25, or equivalent)	8410-1040

* For use between microphone and instrument input.
** For use between output of 1560-P40 Preamplifier and instrument input; has extra conductor to carry dc power to preamplifier.

Operating Procedures –Section 2

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2.1 DIMENSIONS.

The dimensions of the 1561-R are shown in Figure 2-1.

2.2 CABINET.

The 1561-R is enclosed in a steel cabinet that includes all necessary provisions for mounting in a standard 19-inch relay rack with universal mounting-hole spacing according to EIA Standard RS-310. Rear-support brackets are included and slides allow the instrument to be removed easily from the cabinet for adjustment of internal controls or for servicing.

2.3 LOCATION.

The 1561-R can be rack mounted in any location where environmental conditions are within the limits noted in the Specifications and in paragraph 2.11. Avoid exposing the instrument to strong magnetic fields or excessive vibration (refer to paragraphs 2.10.2 and 2.10.5).

2.4 INSTALLATION.

To install the Sound-Level Meter in an EIA standard 19-inch relay rack, proceed as follows:

a. Remove the four panel screws, slide the instrument out of the cabinet. (Refer also to paragraph 5.4.)

b. Insert the cabinet in the rack and secure it to the front of the rack with the front-support screws (Figure 2-2).

c. If the rack contains a rear support, remove the rear-cover screws and remove the cover. Attach the brackets to the cabinet with the rear-bracket screws and nuts; use the set of slots that most nearly aligns the bracket with the rear support. Secure the bracket to the rear support.

d. Push the tracks all the way into the cabinet. Place the rear of the instrument in the cabinet, lift the rear so that the rear slide-blocks straddle the tracks, and push the instrument in until it stops. Lift the front, pull the instrument out so that the tracks follow, and then push in so that the front slide-blocks straddle the tracks. Push the instrument all the way in and secure it to the rack with the four panel screws.

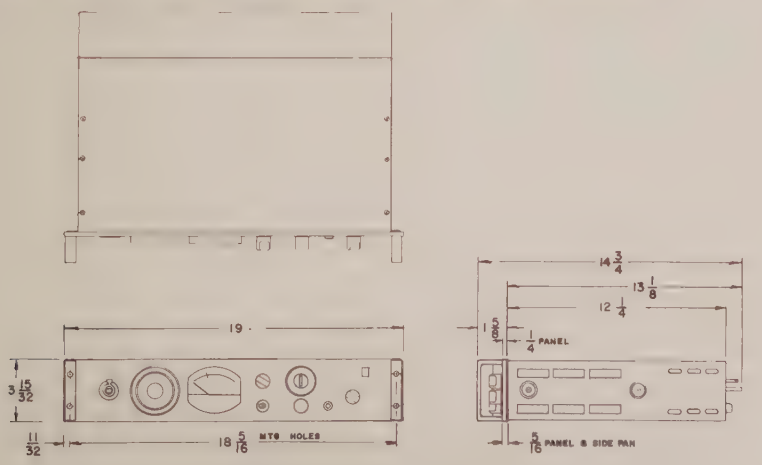


Figure 2-1. Dimensions of the cabinet, in inches.

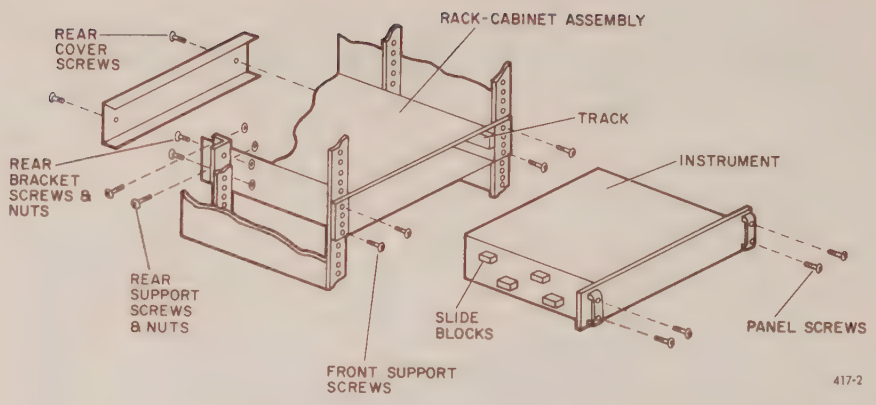


Figure 2-2 Method of mounting the Sound-Level Meter in an EIA standard 19-inch relay rack.

2.5 POWER SUPPLIES.

2.5.1. Line Power.

A 115- or 230-V, 50- to 60-Hz power line is ordinarily used to furnish power for the 1561-R. Set the slide switch (2, Figure 1-7) on the rear panel to the voltage of the power line being used. Connect the instrument to the power line, using the power cord supplied (P/N 4200-9622).

NOTE

The 1561-R is normally supplied without batteries. The jumper lead (which is supplied to connect the batteries in series when they are used) should join the two battery leads when line power is used. (Refer to paragraph 5.5 and Figure 2-3.)

Figure 2-3. The jumper lead is used to join the two battery leads when batteries are not used.

2.5.2. Batteries.

To isolate the instrument from the power line (to avoid noise problems) or to facilitate its use where a power line is not available, rechargeable nickel-cadmium batteries (GR P/N 8410-1040 or equivalent; refer to paragraph 5.5) can be mounted inside the cabinet and will serve as a power source when the function switch on the front panel is set to BATTERY POWER. The charged condition of the batteries can be checked by setting the function switch to CHECK; the meter should read in the area marked BAT. Fully charged batteries will usually read slightly below the center of the BAT area and will operate the instrument for 20-24 hours. If the meter reads on or below the low edge of the BAT area, the batteries need recharging.

The batteries can be charged from the power line through an internal circuit. Connect the instrument to the line and set the function switch to BATTERY CHARGE. A full charge requires 14-16 hours.

CAUTION

The nickel-cadmium batteries should not be kept continuously on charge when not in use. An occasional charging period as long as two or three normal charging periods can be tolerated, but continuous charging may result in permanent damage to the batteries.

While the batteries are being charged, the meter will indicate well into the BAT area. If the 1561 is disconnected from the power line, the meter reading will be an indication of the open-circuit battery voltage. With the function switch at BATTERY CHECK, the meter reading is an indication of the battery voltage under load.

Do not leave the function switch in the CHARGE position when the 1561 is connected to the power line with no batteries installed. If the battery leads are not connected together, a diode protects the meter from possible damage by the open-circuit charging voltage, but the meter will read approximately full scale. If the battery leads are connected together, the meter will not indicate. However, about 5 W of power will be dissipated in resistor R510 (see Figure 5-11). When batteries are not in place, connect the battery leads together using the jumper lead supplied and place the leads in the insulating sleeve provided. (Instructions for installing the batteries are given in paragraph 5.5.)

The nickel-cadmium batteries are not recommended for prolonged use beyond the temperature range of -18 to

+46° C (0 to 115° F). Excessively high or low temperatures may cause the batteries to leak.

The batteries are not supplied with the instrument.

2.6. GROUNDING.

Grounding of the chassis of the 1561-R is usually accomplished through the grounding system of the relay rack in which it is mounted or by the grounding wire of the three-wire power cord. A bus wire connects the chassis to the circuit ground (see Figure 5-5). This wire can be unsoldered, leaving the circuit isolated from the chassis by a 30-Ω resistor in parallel with a 1-μF capacitor. This isolation reduces background electrical noise that can be caused by ground currents in the input-cable shield. Such currents may be present when the chassis of the 1561-R is connected to the chassis of other instruments being used in a measurement system.

2.7. CALIBRATION CHECK.

Before using the Type 1561 Precision Sound-Level Meter, make the following simple calibration check. (This check calibrates the amplifier of the sound-level meter, but does not include a check on the microphone.)

a. Turn the instrument on by turning the power switch to LINE or (if equipped with batteries) to BATTERY POWER.

b. Set the DECIBEL controls so that the dots on the inner and outer dials line up with the CAL dot on the panel. The dials should read 130.

c. Set the MICROPHONE SENSITIVITY LEVEL dial (on the front panel) to the sensitivity figure for the microphone being used.

If a 1560-P7 Precision Microphone is used with a 1560-P40 Preamplifier and is connected to the Sound-Level Meter by a cable, set the dial to a figure 0.1 dB less, algebraically, than the open-circuit sensitivity of the microphone. For example, if the open-circuit sensitivity is -61.7 dB re 1 V/μbar, set the dial to -61.8 dB (-61.7 dB - 0.1 dB).

If the 1560-P7 Microphone is connected directly to the 1561 by a 10-foot cable (P/N 1560-2500), the dial setting to be used can be determined from the nomogram of Figure 2-4. To use the nomogram, place a straight edge at the microphone-sensitivity and capacitance values on the outer two scales and read the dial setting on the middle scale. (Microphone open-circuit sensitivity and capacitance limits for the nomogram are -58 to -62.6 dB re 1 V/μbar and 350-450 pF, respectively). The open-circuit sensitivity and capacitance of each 1560-P7 Microphone are given on a tag furnished with the microphone.

NOTE

This tag also gives the setting of the MICROPHONE SENSITIVITY LEVEL dial to be used when a 1560-P7 Precision Microphone and a 1560-2500, 10-foot Cable are ordered for use with the 1561-R.

If the microphone is connected directly to the Sound-Level Meter by any other cable, the open-circuit sensitivity figure must be corrected for the loading effect of the cable capacitance and the input capacitance of the sound-level meter. The dial setting can be determined by the following formula:

$$\text{Dial Setting} = S_M - 20 \log_{10} \left(\frac{C_M + C_C + C_I}{C_M} \right)$$

where

S_M = open-circuit sensitivity of microphone

C_C = capacitance of extension cable

C_I = input capacitance of 1561

The input capacitance of the 1561-R is 90 pF.

Example: The setting of the MICROPHONE SENSITIVITY LEVEL dial is calculated below for a 1560-P7 Precision Microphone connected to the Sound-Level Meter by a 15-foot cable.

Microphone sensitivity = 61.7 dB re 1 V/μbar
Microphone capacitance = 395 pF
Cable capacitance = 325 pF

$$\text{Dial setting} = -61.7 - 20 \log_{10} \frac{395 + 325 + 90}{395}$$

$$= -61.7 - 6.2$$

$$= -67.9 \text{ dB re 1 V/μbar}$$

If the microphone sensitivity figure is beyond the range of the dial (-57 dB to -67 dB re 1 V/μbar) as in the example, set the dial to a sensitivity figure 10 dB lower or higher (algebraically). When subsequent sound-pressure-level readings are made, subtract 10 dB if the dial was set lower and add 10 dB if it was set higher.

EXAMPLES

Sensitivity Figure(dB)	Dial Setting	Reading for Sound-Pressure Level of X dB	Correction
-54.5	-64.5	X + 10 dB	Subtract 10 dB
-67.9	-57.9	X - 10 dB	Add 10 dB

d. Set the WEIGHTING switch to CAL.

e. If the meter pointer does not indicate near the center of the CAL area on the meter face, set it there by adjusting the CALIBRATE control on the panel and/or the GAIN control on the etched board inside the instrument (see Figure 5-6).

NOTE

For minimum circuit noise, set the CALIBRATE control as far counterclockwise as possible. Increase the gain with the CALIBRATE control only if the GAIN control is at its maximum setting.

f. Reset the WEIGHTING switch to the desired characteristic. (Refer to paragraph 2.9.4 before initiating a measurement.)

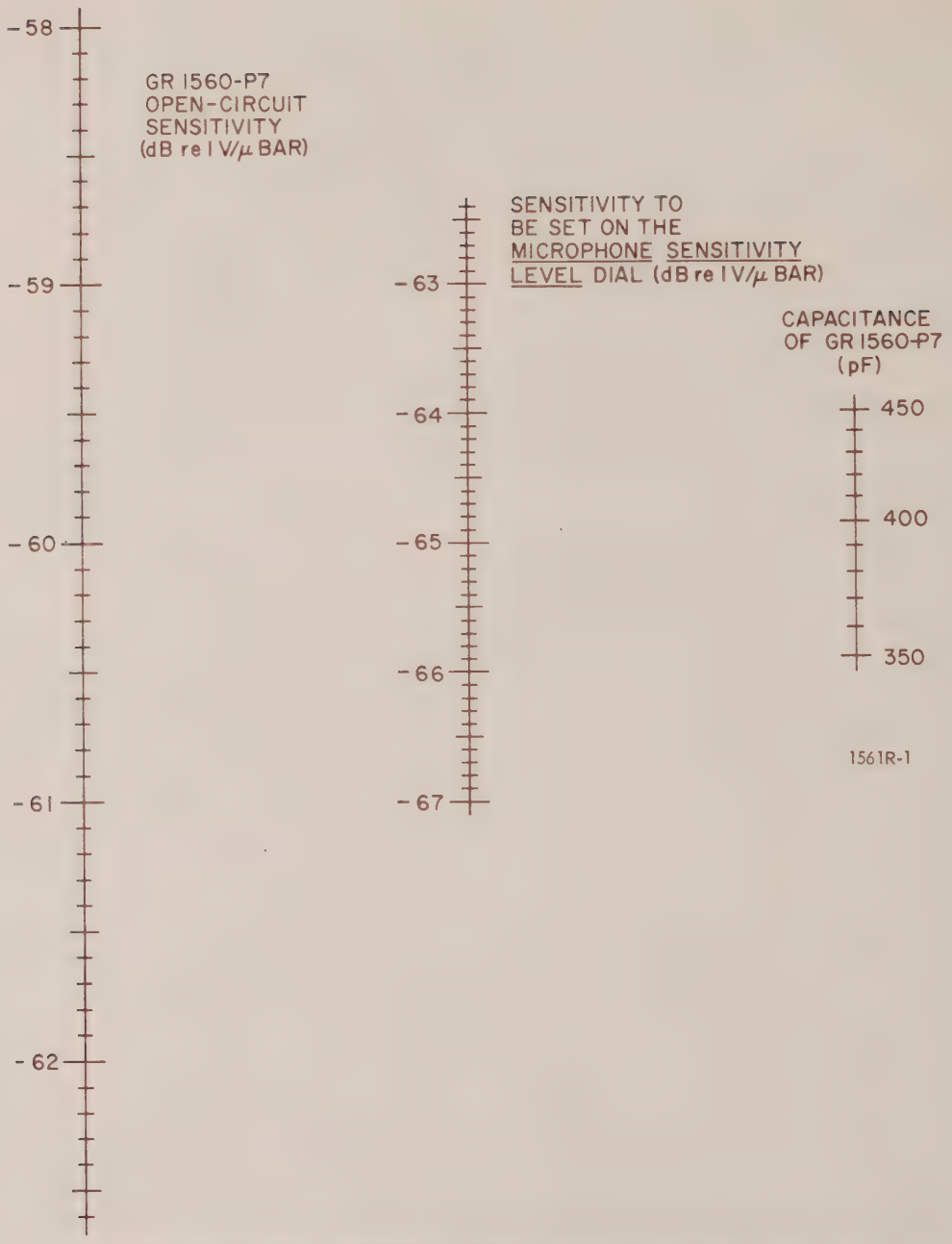


Figure 2-4. Nomogram to determine the setting of the MICROPHONE SENSITIVITY LEVEL dial when the 1560-P7 Microphone is used with the 10-foot extension cable.

2.8 ACOUSTICAL CALIBRATION.

The following over-all acoustical calibration can be made with the Type 1562 Sound-Level Calibrator. This calibration checks the microphone sensitivity as well as the amplifier sensitivity. It should be made whenever doubt exists about the condition of the microphone.

Perform the calibration check as described in paragraph 2.7. Then set the WEIGHTING switch to FLAT. Turn on the calibrator and set its frequency to 500 Hz. Place the calibrator over the microphone. The sound-level meter should read 114 ±0.5 dB (refer to paragraph 2.10 for the method of reading the meter). If it does not, set it to 114 dB using the CALIBRATE or GAIN control (refer

to NOTE, Paragraph 2.7). Switch the calibrator to each of its other frequencies (125, 250, 1000, and 2000 Hz). If the readings at the various frequencies vary by more than ±1 dB, it is possible that the microphone has been damaged and it should be checked independently.

The above calibration will be made free of charge for any GR sound-level meter delivered to one of the General Radio offices listed elsewhere in this manual.

2.9 SETTING THE CONTROLS.

2.9.1 Power.

Turn the instrument on by setting the power function switch either to LINE or to BATTERY POWER (if the instrument is equipped with batteries).

2.9.2 Meter Switch.

Set the METER switch at either FAST or SLOW. Fast response is suitable for most noise measurements and for measurements of minimum and maximum values of fluctuating sound. Slow response provides a high degree of damping for measuring the average value of fluctuating sounds. The fast and slow response characteristics are as specified by IEC 179 (1965).

2.9.3 Attenuator.

Use the following procedure to set the DECIBELS attenuator controls. This procedure ensures that the input amplifier stage, which precedes weighting networks in the signal path, is not overloaded by the input signal.

With the signal to be measured connected to the input, turn the DECIBELS knob and large dial fully clockwise. Set the WEIGHTING switch to FLAT. If the meter pointer is above full scale, adjust the large dial for a reading between 0 and +10 on the meter. If the meter pointer is below 0 or down, off scale, adjust the knob for a reading between 0 and +10 on the meter. Then set the WEIGHTING switch to the desired characteristic (refer to paragraph 2.9.4). After the WEIGHTING has been set, use only the DECIBELS knob to adjust the gain for a usable meter reading. Never readjust the large dial except when the small knob has been turned fully clockwise and the WEIGHTING switch set to FLAT.

2.9.4. Selection of Weighting Network.

When a single number rating of a noise is desired, an A-weighted sound-level reading is usually preferred. In the absence of specific weighting requirements, it is usually helpful to make measurements on all three weighting networks.

NOTE

For a full discussion of weighting networks, refer to the General Radio *Handbook of Noise Measurement.*

Electrical response curves for the various weighting networks are given in Figures 2-5, 2-6, and 2-7. An electrical FLAT frequency response characteristic, also provided, is shown with tolerances in Figure 2-8.

If the sound-level meter is to be used with an analyzer or recorder, set the WEIGHTING switch to FLAT or to C.

An EXT FILTER position is also provided by the WEIGHTING switch, making it possible to insert a special filter network in cascade with the amplifier. There are two EXT FILTER phone jacks on the rear panel of the instrument. The input to a filter should be plugged into the upper jack, and the output from the filter into the lower jack. When the WEIGHTING switch is set at EXT FILTER, all other weighting networks are removed from the circuit. The frequency response of the instrument (excluding the external filter) is the FLAT response. The gain of the amplifier is about 2 dB greater than when the FLAT switch position is used. The source impedance for the external filter is about 5 Ω resistance in series with 60 μF. The load impedance on the filter is 10 kΩ in parallel with about 100 pF. The instrument will operate at full capability with a filter input impedance of 600 Ω. If the input and output impedances of the filter are matched, there will be at least a 6-dB loss in gain. This loss will be reduced by the 2-dB increase in gain mentioned above. It is recommended that a network having a flat frequency response and the same pass-band insertion loss and input and output impedances as the filter be connected to the EXT FILTER jacks to determine the actual loss in over-all gain from the normal FLAT response characteristic. When the network is connected and a signal is applied to the instrument input connector, the loss in gain can be determined by turning the WEIGHTING switch from EXT FILTER to FLAT and noting the change in the meter reading.

The Type 1952 Universal Filter is recommended for use as an external filter with the Type 1561-R. (Use a 1560-P95 Adaptor Cable to connect the two instruments.)

2.10. USING THE SOUND-LEVEL METER.

2.10.1. Sound-Level Measurements.

In order to obtain the accuracy required for precision sound-level measurements, the instrument and the observer should not be near the point at which the sound is to be measured. Diffraction and reflection of sound waves from the instrument and the observer may distort the sound field at the microphone and cause errors in excess of the tolerance allowed by the standard for precision sound-level meters. Support the microphone (refer to paragraph 1.2.2) either by a tripod or by suspending it on a strong, small-diameter cord. Connect the microphone to the sound-level meter with a 10-foot, or longer, cable (refer to paragraph 2.10.4).

Locate the sound-level meter far enough from the microphone so that changes in the instrument position and movement of the observer do not significantly affect the indication of the meter.

Adjust the DECIBELS switches (refer to paragraph 2.9.3) for an on-scale deflection of the meter. The deflec-

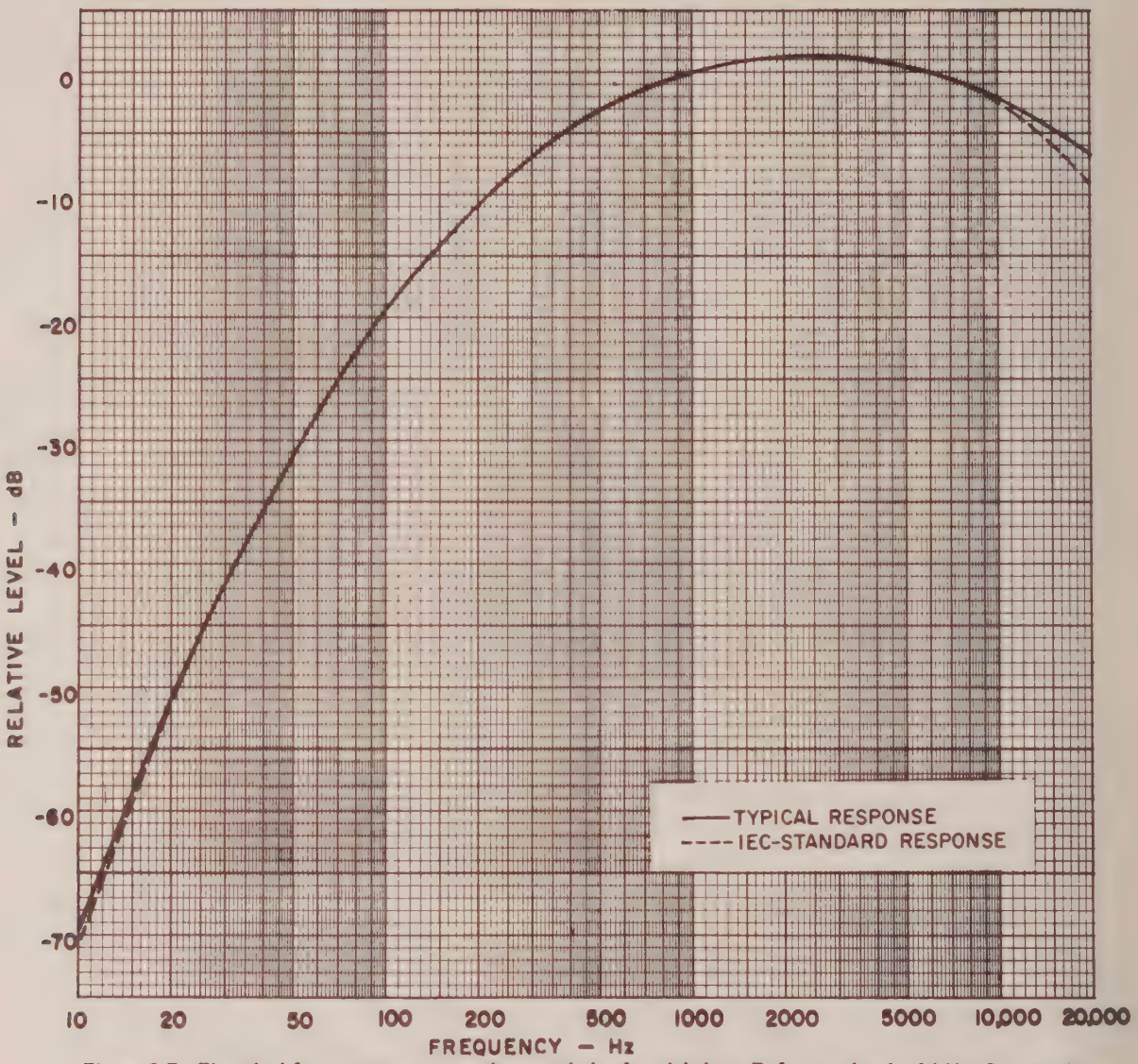


Figure 2-5. Electrical frequency-response characteristic, A weighting. Reference level: 1 kHz, C weighting.

tion should be as high on the scale as possible, because the most accurate portion of the scale is between 0 and +10. The sound level in decibels is the algebraic sum of the readings of the DECIBELS controls and meter.

2.10.2. Sound Analysis and Recording.

The low-distortion output-amplifier circuit of the sound-level meter was designed especially for use with the Type 1558 Octave-Band Analyzer, the 1564 Sound and Vibration Analyzer, the 1568 Wave Analyzer, and the 1900 Wave Analyzer. Connect the input of the analyzer or recorder to an OUTPUT phone jack on the sound-level meter. The output impedance at the jack is 5.5 kΩ in series with 15 μF. The nominal output voltage is 1.25 V, open circuit, 1.0 V across 20,000 Ω. Any load impedance can be connected across the OUTPUT terminals without affecting the output waveform or the meter reading.

The output system of the sound-level meter can be used to drive a Type 1521 Graphic Level Recorder, to obtain permanent records of sound measurements, or to operate a magnetic tape recorder to obtain field records that can be studied and analyzed later, in the laboratory. When recording or analyzing, set the DECIBELS switches for a meter reading of +6 dB or higher, so that the maximum dynamic range can be utilized. When the DECIBELS control and the WEIGHTING switch are set to CAL, the 1000-Hz calibration signal is available at the OUTPUT jacks. The signal is useful for setting the level of an analyzer or recorder to match that of the sound-level meter.

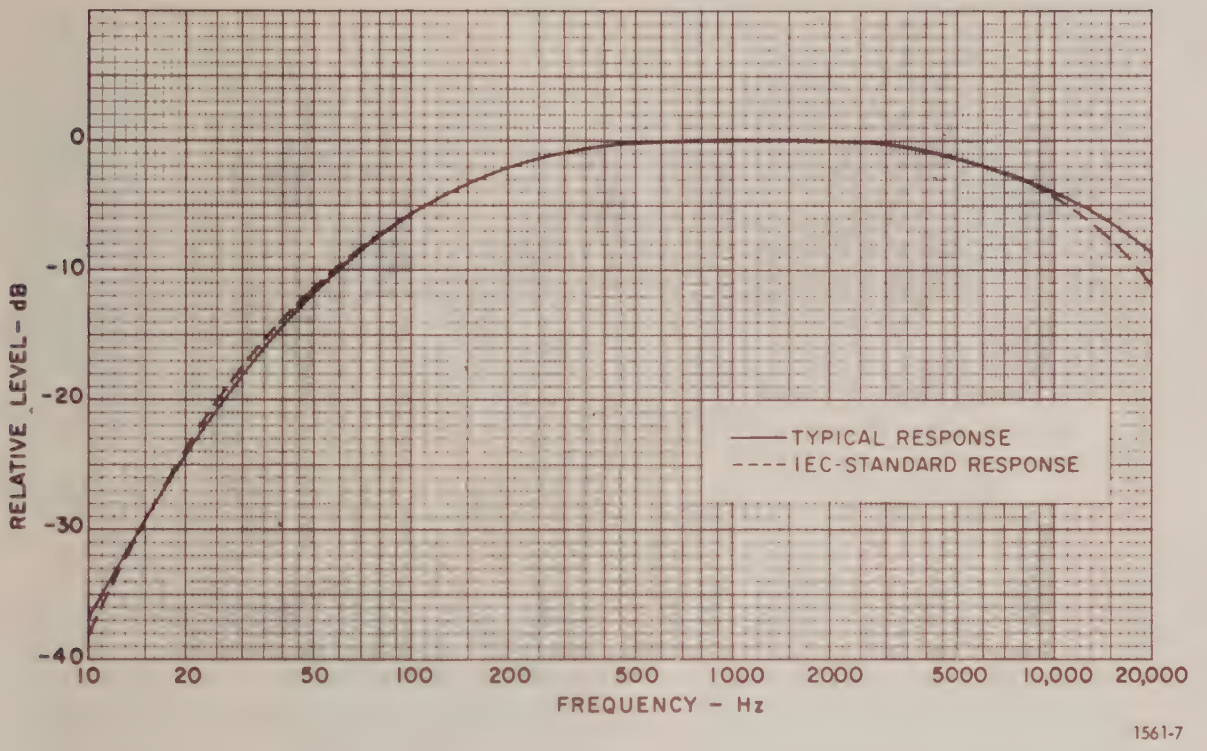


Figure 2-6. Electrical frequency-response characteristic, B weighting. Reference level: 1 kHz, C weighting.

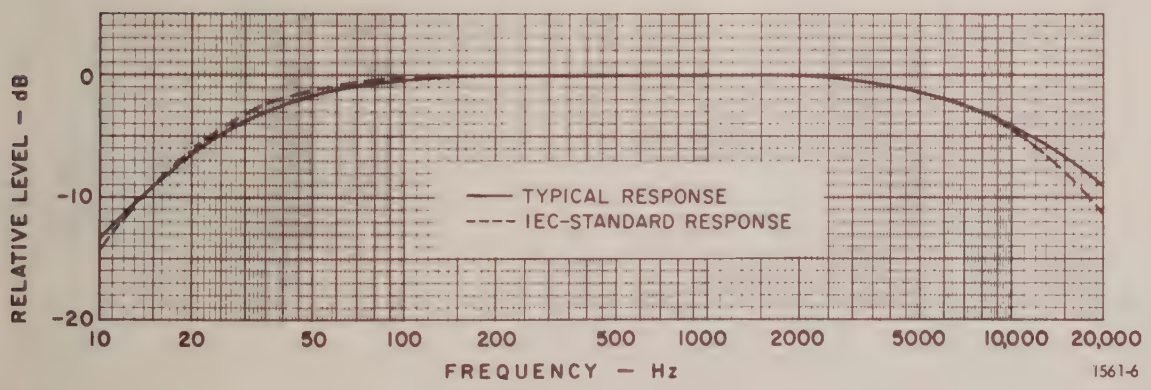


Figure 2-7. Electrical frequency-response characteristic, C weighting. Reference level: 1 kHz, C weighting.

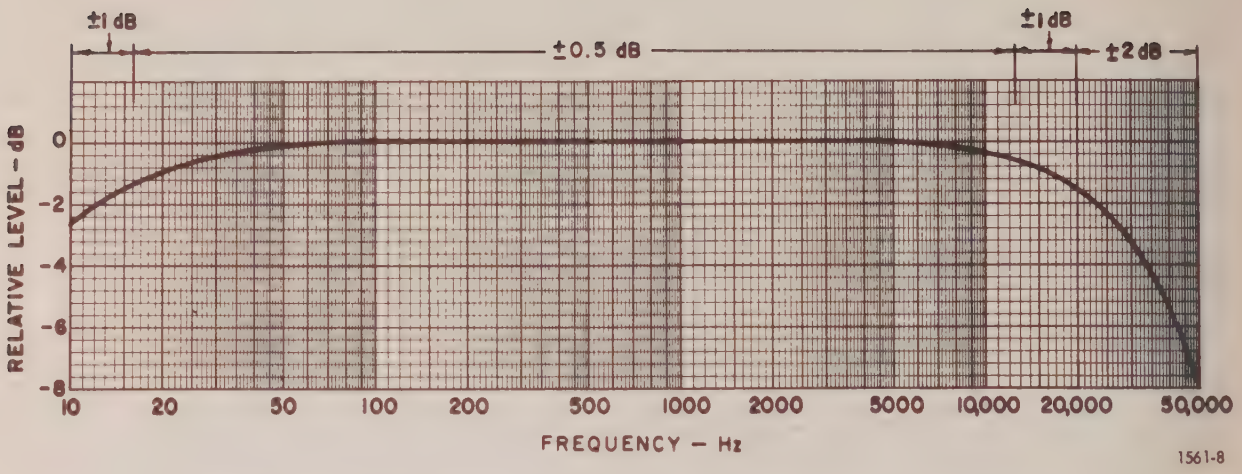


Figure 2-8. Electrical flat response characteristic. Reference level: 1 kHz, C weighting.

2.10.3. Vibration Measurements.

It is often desirable to measure vibration amplitude, velocity, or acceleration of radiating surfaces. Useful vibration measurements can often be made where high ambient sound levels make acoustic measurements impossible. For vibration frequencies between 20 and 2000 Hz, the 1561-R can be used with the Type 1560-P11B Vibration Pickup System to operate as a vibration meter.[1] For vibration measurements between 20 and 10,000 Hz, the Type 1560-P13 Vibration Pickup System can be used.

The reader should refer to the General Radio *Handbook of Noise Measurement* for further information on vibration measurements.

2.10.4. Extension Cables.

When precision sound-level measurements are to be made, the microphone must be connected to the instrument by an extension cable at least 10 feet long. The cable allows the observer and the instrument to be far enough from the microphone so that the sound field is not significantly changed by their presence (refer to paragraphs 2.10.1 and 3.2).

An extension cable, used to connect the microphone to the Sound-Level Meter, causes some loss of signal at the input connector. Three microphone extension cables are available, 10, 25 or 100 feet in length (refer to paragraph 1.4). If the 10-foot cable (P/N 1560-2500) is used with the 1560-P7 Microphone, the setting of the MICROPHONE SENSITIVITY LEVEL dial for electrical calibration of the amplifier gain can be determined from the nomogram in Figure 2-4. The 25-foot cable (P/N 1560-9673) causes a signal loss of about 7 dB and the 100-foot cable (P/N 1560-9982) a loss of about 16 dB. The setting of the MICROPHONE SENSITIVITY LEVEL dial can be calculated if the capacitance of the cable is known (refer to paragraph 2.7). The calibration can also be made acoustically with the Type 1562 Sound-Level Calibrator. The Calibrator output level is 114 dB. When calibrating the 1561 with the 1560-P7 Microphone and the 25-foot cable, adjust the GAIN and CALIBRATE controls (refer to paragraph 2.7) for a reading of 114 dB. When the 100-foot cable is used, adjust the gain for a reading of 104 dB and add 10 dB to subsequent measurement readings to obtain the true sound level.

Whenever the sound level to be measured is 130 dB or less, a Type 1560-P40 Preamplifier and Type 1560-P72 25-foot or P72B 100-foot Extension Cable (refer to paragraph 1.4) should be used after the microphone. When this Preamplifier is used, the cable loss is eliminated and the signal-to-noise ratio is significantly improved. The 1561-R can be calibrated with either its internal calibrating system (refer to paragraph 2.7) or with the 1562 Sound-Level Calibrator.

2.10.5. Use of Headphones.

If desired a set of headphones can be plugged into either OUTPUT jack to monitor the sound being measured.

2.11. ENVIRONMENTAL EFFECTS.

2.11.1. Background Noise.

Whenever possible, sound measurements should be made with negligible background noise - - at least 10 dB below the level being measured. However, this is not always possible, and Figure 2-9 can be used to determine the error caused by the background noise.

[1] Gross, E.E., "Vibration Measurements with the Sound-Level Meter," General Radio *Experimenter*, Volume 39, No. 7, July, 1965.

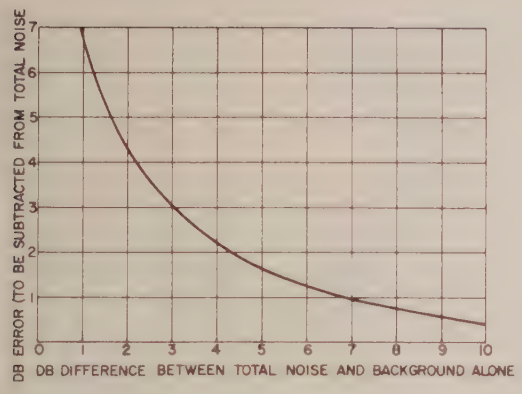


Figure 2-9. Measurement error caused by background noise.

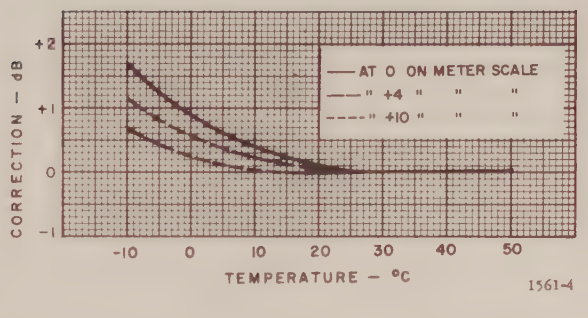


Figure 2-10. Temperature correction for Type 1561 Precision Sound-Level Meter, including 1560-P7 Precision Microphone attached to 1560-P40 Preamplifier.

2.11.2. Magnetic Fields.

When oriented for maximum sensitivity to a 60-Hz, 1-oersted, magnetic field, the sound-level meter will indicate as shown in Table 2-1. The gain is adjusted for a microphone sensitivity of -60 dB re 1 V/μbar. Set the input attenuator (large DECIBELS dial) fully clockwise, and the CALIBRATE control about 30° (approximately 1 dB increase in gain) from the fully counterclockwise position.

TABLE 2-1

EFFECT OF A MAGNETIC FIELD (REFER TO TEXT)

Weighting	Maximum Meter Indication (dB)
Flat	43
C	42
B	46
A	46

With a given condition of magnetic pickup, a change in the setting of the input attenuator has a relatively small effect on the pickup in the amplifier and, therefore, the panel-meter indication remains relatively constant.

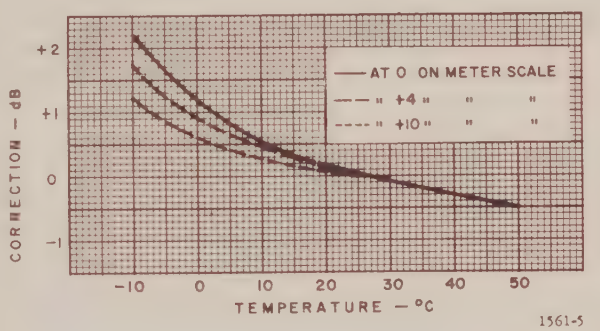


Figure 2-11. Temperature correction for Type 1561 Precision Sound-Level Meter, including 1560-P7 Precision Microphone attached to the 10-foot cable.

2.11.3. Electrostatic Fields.

The Type 1561-R is completely enclosed in a metal case and is not affected by electrostatic fields that are normally encountered.

2.11.4. Effects of Temperature and Humidity.

Except for the batteries, the Type 1561-R Sound-Level Meter is not damaged by temperatures between -40° and +60° C or by relative humidities between 0 and 100%.

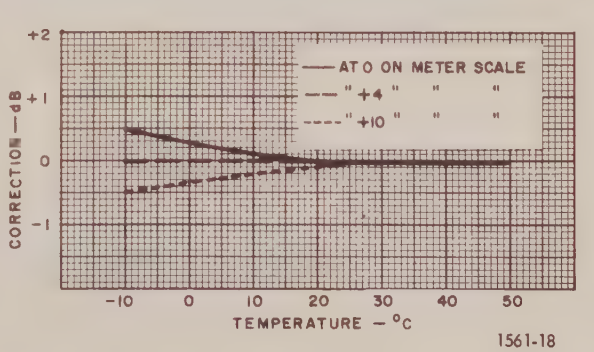


Figure 2-12. Temperature correction for Type 1561 Precision Sound-Level Meter calibrated by an acoustic input signal of 114 dB re 20 $\mu N/m^2$ (Type 1562) at the ambient temperature where the Sound-Level Meter is being used.

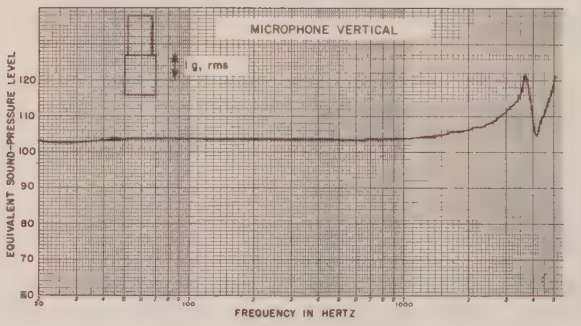
When standardized by its internal calibration system or by a 1562 Sound-Level Calibrator, the 1561 will operate within catalog specifications (for panel-meter indications above 0 dB) over the temperature range of 10° to 50° C and the relative humidity range of 0-90%. Corrections for temperatures down to -10° C are given in Figures 2-10 and 2-11.

If the instrument is calibrated with a 1562 at the ambient temperature at which the sound measurements are made, the effects of temperature on the 1561 at +4 on the meter scale (1562 output is 114 dB) and on the microphone will be automatically compensated. Corrections for temperature errors at other points on the meter scale can be obtained from the curves of Figure 2-12. (Apply any necessary corrections to the 1562 output required because of the effects of temperature and atmospheric pressure, refer to Instruction Manual for the 1562 Sound-Level Calibrator.)

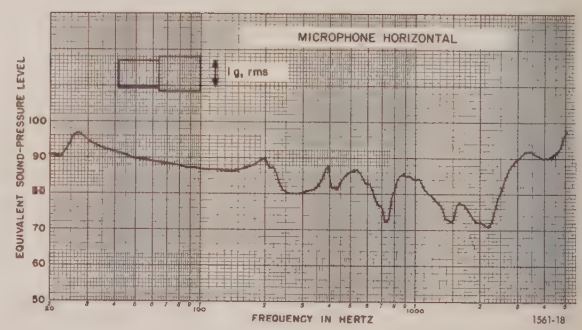
Measurements made with the 1561 will not be affected by normal changes in barometric pressure.

2.11.5. Vibration.

The rack-mounted 1561-R will seldom be subjected to mechanical vibration severe enough to cause erroneous sound-level readings. However, excessive vibration of the microphone may have considerable effect on a measurement. The microphone should be supported so that it is protected from excessive vibration. The outputs in equivalent sound-pressure level from a 1560-P7 Microphone vibrated at 1 g along two different axes are shown in Figure 2-13.



a.



b.

2-13. Typical outputs in equivalent sound-pressure level from a Type 1560-P7 Precision Microphone subjected to mechanical vibration, with 1 g, rms, acceleration a) parallel and b) perpendicular to the longitudinal axis of the microphone.

Calibration–Section 3

3.1 GENERAL 3-1
3.2 OBSERVER INFLUENCE 3-1
3.3 PREFERRED ANGLE OF INCIDENCE 3-1
3.4 AUXILIARY CALIBRATION 3-1
3.5 METER CIRCUIT 3-2

3.1. GENERAL.

The calibration (acoustical and electrical) of the 1561 Precision Sound-Level Meter is carried out with pure tones. Calibration of the recommended 1560-P7 Microphone is made at 0 degrees (perpendicular) incidence in a free field. A curve is supplied with this Microphone for random-incidence response, and a typical curve is shown in Figure 1-3. Curves for the perpendicular and grazing responses can be obtained by applying the corrections of Figure 1-5.

3.2. OBSERVER INFLUENCE.

When measurements are made in reverberant or semi-reverberant fields, the observer and the case of the sound-level meter have a small effect upon the microphone response.[1] Under free-field conditions, with a single sound source, both the observer and the case may have a great effect on the microphone response (refer to the General Radio *Handbook of Noise Measurement*).

Precision sound-level measurements should only be made with the Microphone supported in position by a tripod or by suspending it with a strong small-diameter cord. Connect the microphone to the sound-level meter with an extension cable (refer to paragraph 2.10.4).

[1] Young, R.W., "Can Accurate Measurements be Made with a Sound-Level Meter Held in Hand?" *Sound*, 1, 1, 17-24, January-February, 1962.

3.3. PREFERRED ANGLE OF INCIDENCE.

When measurements are made on sounds in reverberant fields, the angle of incidence of sounds reaching the microphone is indeterminate. In this case, there is no preferred angle of incidence between the microphone and the sound source. When measurements are made on a source in a free field, an angle of incidence of 70° between the axis of the microphone and the sound source will approximate random response.

3.4. AUXILIARY CALIBRATION.

(Refer to paragraphs 2.7 and 2.8.)

The Type 1561 has an internal calibration system for a quick check on the electrical circuit of the instrument. This system connects the output of the amplifier to the input through an appropriate attenuator, filter, and limiter, to produce a predetermined oscillation amplitude when the amplifier gain is correct. This checks the electrical operation only and does not check the microphone. To make an acoustical check on the calibration of the instrument, the Type 1562 Sound-Level Calibrator is recommended. This instrument consists of a closed coupler with a driving loudspeaker that produces a known sound-pressure level at the microphone.

3.5. METER CIRCUIT.

The meter circuit used in the sound-level meter indicates the rms value of the sound level as specified in USAS S1.4-1961 and IEC 179 (1965).

Table 3-1 shows the dB difference between the indication of a true rms meter and that of the 1561 Precision Sound-Level Meter for several test signals. In the column headed "dB Fluctuation....etc" the signal consists of two tones. One, at 1000 Hz, is set for a convenient meter indication. The other tone is within a few hertz of 3000 and has 30 percent as great an amplitude as the first. A true-rms meter will show no fluctuation with this type of signal. The column headed "For Two-Signal Addition" refers to the two-signal test outlined in IEC 179 (1965).

With pulses of constant height but varying length, the Type 1561 indicates the rms value within 1 dB until the pulse duration becomes as short as 1/25 of that of a square wave.

Table 3-1
INDICATION OF 1561 VS THAT OF A TRUE RMS METER

Difference between 1561 Meter Indication and rms Decibels			**dB Fluctuation with Phase Changes at 30% 3rd Harmonic**
For Two-Signal Addition	For Square Waves	For Noise	
+0.05	+0.1	-0.25	0.45

Principles of Operation—Section 4

4.1 GENERAL 4-1
4.2 THE AMPLIFIER 4-1
4.3 METER AND OUTPUT CIRCUITS 4-1
4.4 CALIBRATION CIRCUIT 4-1

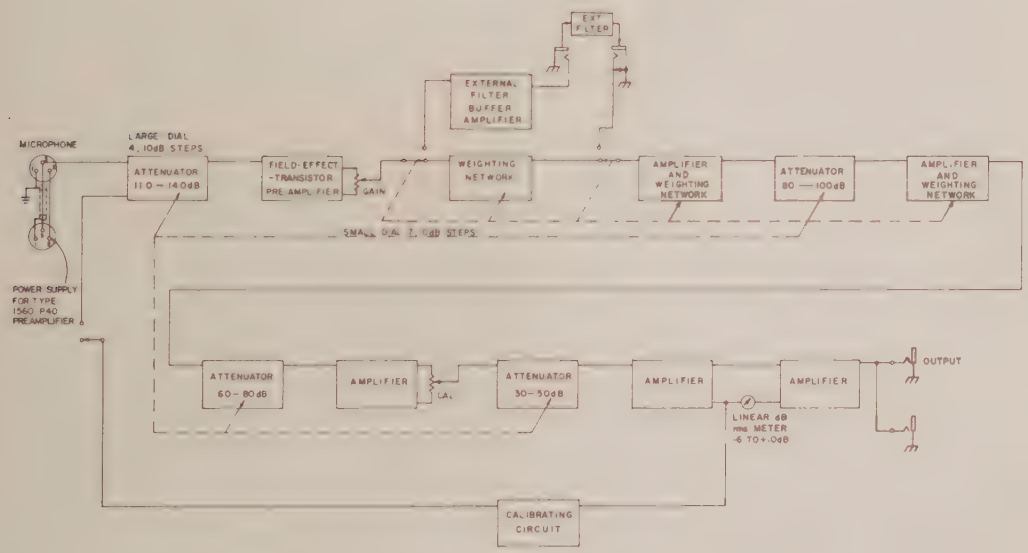


Figure 4-1. Elementary block diagram of the Type 1561-R Precision Sound-Level Meter.

4.1 GENERAL.

The Type 1561 is a calibrated, high-gain amplifier that includes accurate attenuating and weighting networks, a calibrating circuit, meter and output circuits and input and output connectors. A block diagram is shown in Figure 4-1.

4.2 THE AMPLIFIER.

The amplifier consists of several feedback-stabilized stages with attenuator sections located between them to give optimum signal-to-noise ratios. Frequency-response weighting networks are also located in and between the amplifier stages. The pre-amplifier stage uses a low-noise field-effect transistor to produce a high-input-impedance, very-low-noise stage for the initial amplification of the low-amplitude signal from the microphone. At high signal levels, an input attenuator reduces the input-signal amplitude to prevent overloading of the preamplifier. A buffer amplifier is also included to drive an external filter.

4.3 METER AND OUTPUT CIRCUITS.

The meter and output-amplifier circuits are designed so that any load on the output has no effect of the meter reading. The meter circuit gives a quasi-rms[1] indication.

4.4 CALIBRATION CIRCUIT.

Amplifier gain can be set by means of a calibrated feedback circuit connected from amplifier output to input. The gain is set in terms of the sensitivity of the microphone being used. When the gain is correctly adjusted, the meter indicates in a marked area, and the amplifier-feedback system oscillates at about 1000 Hz. The signal is available at the output terminals.

[1] Gross, E. E., "Improved Performance Plus a New Look for the Sound-Level Meter," General Radio Experimenter, Vol. 32, No. 17, October 1958.

Service and Maintenance—Section 5

5.1 WARRANTY 5-1
5.2 SERVICE 5-1
5.3 MINIMUM-PERFORMANCE STANDARDS 5-1
5.4 REMOVING INSTRUMENT FROM CABINET 5-4
5.5 INSTALLING AND REMOVING BATTERIES 5-4
5.6 KNOB REMOVAL 5-4
5.7 KNOB INSTALLATION 5-5
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5.1 WARRANTY.

We warrant that each new instrument manufactured and sold by us is free from defects in material and workmanship, and that, properly used, it will perform in full accordance with applicable specifications for a period of two years after original shipment. Any instrument or component that is found within the two-year period not to meet these standards after examination by our factory, District Office, or authorized repair agency personnel, will be repaired, or, at our option, replaced without charge, except for tubes or batteries that have given normal service.

5.2 SERVICE.

The two-year warranty stated above attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please write or phone our Service Department (see rear cover), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the type and serial numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest District Office, requesting a "Returned Material Tag." Use of this tag will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

5.3 MINIMUM-PERFORMANCE STANDARDS.

5.3.1 General.

The equipment listed in Table 5-1 is required for incoming inspection, periodic operational checks, calibration verification, or trouble analysis of the Sound-Level Meter. The procedures are given in the following paragraphs.

5.3.2 Gain Test.

Make the setup shown in Figure 5-1. Make the input to the 1561 through a shielded lead terminated in a 3-terminal audio connector, such as the Cannon, Model XLR-3-12C, which plugs directly into the MICROPHONE input socket on the panel. Use terminals #1 and #3, with the shield connected to #1.

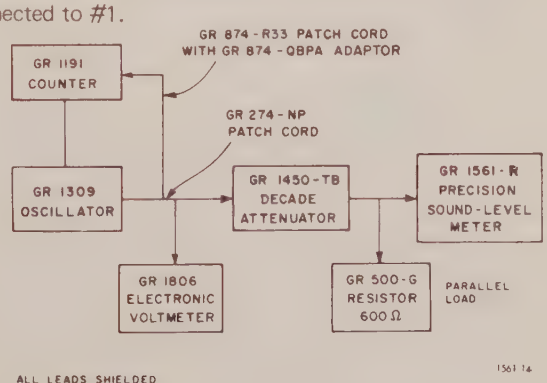


Figure 5-1. Test setup for checking the gain.

Table 5-1
TEST EQUIPMENT

Function Name	Minimum Requirements	Recommended*
Oscillator	10 Hz - 50 kHz 5 V, open circuit	GR Type 1309 Oscillator
Oscillator	500 Hz - 10 kHz 10 V across 600 Ω	GR Type 1310 Oscillator
Decade attenuator	0 - 100 dB in 0.1-dB steps. Usable to 50 kHz	GR Type 1450-TB Decade Attenuator
Digital counter	10 Hz - 50 kHz	GR Type 1191 Counter
Distortion meter	10 Hz - 50 kHz	Hewlett Packard Distortion Meter Model 334A
Electronic Voltmeter (VTVM)	Voltage: 0-5 V, rms Frequency: 10 Hz - 50 kHz Accuracy: ± 2% Impedance: 100 kΩ or greater	GR Type 1806 Electronic Voltmeter
Oscilloscope	Sensitivity: 10 mV/cm Frequency: dc - 100 kHz	Tektronix Model 503
Precision Resistor	600Ω ± 1%	GR 500 - G
Resistor	10kΩ ± 5%	
Capacitor	600 pF ± 10%	

*Or equivalent

a. Set the controls as follows:

1309	FREQUENCY	1 kHz
	OUTPUT	1 V
1450-TB		58 dB
1561	DECIBELS-Large dial	Fully cw
	DECIBELS-Small knbb	90
	WEIGHTING	FLAT
	Power	LINE
	METER	FAST
	CALIBRATE control	Fully cw
	GAIN control (R107)	Fully cw

The 1561 meter must read more than 0 dB.

b. Turn the CALIBRATE and GAIN (R107) controls fully ccw. Set the DECIBELS knob at 60. The 1561-R must now read less than +5 dB.

5.3.3. Noise Test.

Use the same setup and settings as in Figure 5-1 and paragraph 5.3.2. With the instrument installed in its case:

a. Set the controls as follows:

1309	FREQUENCY	1 kHz
	OUTPUT	1 V
1450-TB		66.5 dB
1561	DECIBELS-Large dial	Fully cw
	DECIBELS-Small knob	70
	GAIN control	Fully cw

Adjust the CALIBRATE control for a +4 dB indication on the meter.

b. Short the input to the 1561 through a shielded 600-pF capacitor, as shown in Figure 5-2. Change the DECIBELS small knob setting to 30. The noise figures, as read on the meter, must be less than the values given in Table 5-2 for each of the WEIGHTING switch positions.

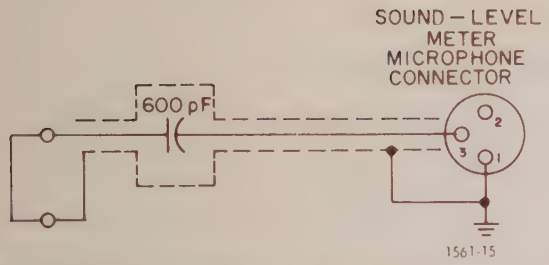


Figure 5-2. For the noise test, the input is shorted through a 600-pF capacitor.

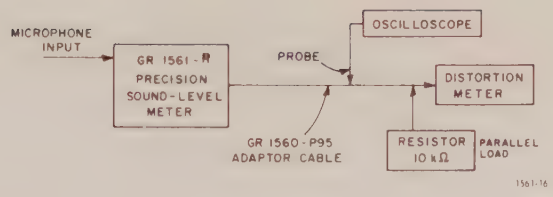


Figure 5-3. Additional equipment to be added to the setup of Figure 5-1 for making the output-level test.

Table 5-2
MAXIMUM ALLOWABLE NOISE FIGURES

Weighting	Meter Reading-dB
FLAT	0
C	-3
B	-4
A	-4

5.3.4 Output-Level Test.

Use the setup of Figure 5-1 and add the circuit of Figure 5-3 at the OUTPUT jack of the 1561. (GR adaptor cable, P/N 1560-9695, can be used.) Set:

1309	FREQUENCY	1 kHz
	OUTPUT	1 V
1450-TB		32 dB
1561	DECIBELS-Large dial	Fully cw
	DECIBELS-Small knob	Fully cw
	WEIGHTING	FLAT
Distortion Meter	FUNCTION	VOLTMETER
	METER RANGE	1 V

Adjust the CALIBRATE control of the 1561 for a full-scale meter reading. The output voltage, as read on the distortion meter, must be between 0.72 and 0.86 V.

5.3.5 Overload Test.

Use the setup and settings of paragraph 5.3.4 (Figures 5-1 and 5-3), except set the 1450-TB at 20 dB. The waveform with this 12-dB overload (as observed on the oscilloscope) must not be clipped on either the positive or negative peaks.

5.3.6 Distortion Test.

Use the setup of paragraph 5.3.4 (Figures 5-1 and 5-3), except set:

1450-TB		0 dB
1561	DECIBELS-Large dial	Fully cw
	DECIBELS-Small knob	Fully cw

Adjust the CALIBRATE control on the 1561 for a full-scale reading on the meter. Disconnect the 1191 Counter. The output distortion of the 1561, as read on the distortion meter, must be less than 0.5%.

5.3.7. Frequency Response.

Use the setup of Figure 5-1, except substitute the 1310 Oscillator for the 1309. Set:

1310	FREQUENCY	1 kHz
	OUTPUT	2 V
1450-TB		65.5 dB
1561	DECIBELS-Large dial	Fully cw
	DECIBELS-Small knob	70
	WEIGHTING	C
	CALIBRATE	Fully ccw

a. Adjust the GAIN control (R107) of the 1561 for a meter reading of +4 dB.

b. Set the WEIGHTING switch on the 1561 to FLAT, B, and A, in turn. In each position, adjust the 1450-TB to give a meter reading on the 1561 of +4 dB. The settings of the 1450-TB must be within the limits specified in Table 5-3.

c. Repeat step b for each frequency in the table. Set the 1310 precisely at each frequency and maintain the 2-V output. Do not change the settings of the CALIBRATE or GAIN controls on the 1561 during this test.

Table 5-3

LIMITS FOR SETTINGS OF DECADE ATTENUATOR—dB

FREQUENCY	WEIGHTING			
	FLAT	C	B	A
1 kHz	65.1 - 66.1	65.5 (REF)	65.2 - 65.8	65.2 - 65.8
5 kHz	65.0 - 66.0	63.9 - 64.5	64.0 - 64.6	65.7 - 66.3
12.5 kHz	64.0 - 66.0	60.0 - 60.6	60.1 - 60.7	61.9 - 62.5
20 kHz	62.9 - 64.9	56.0 - 57.6	56.0 - 57.6	57.9 - 59.5
50 kHz	55.8 - 59.8	— — — —	— — — —	— — — —
500 Hz	65.0 - 66.0	65.2 - 65.8	64.9 - 65.5	62.0 - 62.6
100 Hz	65.0 - 66.0	64.5 - 65.5	59.2 - 60.2	45.9 - 46.9
25 Hz	63.9 - 65.5	59.5 - 61.1	44.2 - 45.8	29.9 - 31.5 [1]
10 Hz	61.8 - 63.8	51.3 - 52.9	27.6 - 29.2	25.3 - 27.5 [2]

[1] Set 1561 DECIBELS small knob to 60.
[2] Set 1561 DECIBELS small knob to 40.

5.4. REMOVING INSTRUMENT FROM CABINET.

To remove the 1561-R from its cabinet:

a. Insert a screwdriver through the holes in the handles and remove the two screws at each end of the panel.

b. Pull the instrument forward on the slide supports until further withdrawal is prevented by the stops.

c. Disconnect any leads to the rear panel.

d. Lift the front of the instrument slightly until it clears the stops and slide the instrument forward, out of the cabinet.

To replace the instrument in the cabinet, run the slide supports through the rear brackets on the sides of the chassis, then reverse the above procedure.

5.5. INSTALLING AND REMOVING BATTERIES.

To operate the 1561-R with batteries, two nickel-cadmium, 9.6-V batteries (P/N 8410-1040) or equivalent should be used. To install the batteries:

a. Remove the instrument from the cabinet (refer to paragraph 5.4) and remove the two screws holding the battery clamp.

b. When the instrument is shipped, the two leads to the battery cable are tied together by the short jumper lead that may eventually be used to connect the two batteries in series (see Figure 2-3). A length of insulating tubing is slipped over the leads. Remove the tubing and disconnect the snap connections.

c. Place the two batteries in the clamp, with the positive terminal (male connector) of the upper battery and the negative terminal (female connector) of the lower battery toward the front of the instrument. Refasten the clamp loosely to the chassis using the two screws.

d. Connect the two cabled battery leads to the front connectors of the batteries. Use the short jumper lead to connect the rear terminals of the two batteries together. Center the batteries in the clamp and tighten the two screws that hold the clamp.

NOTE

If the instrument is to be operated subsequently with no batteries installed, replace the jumper lead to reconnect the two cabled battery leads; also replace the insulating tubing, to prevent the leads from making contact with the chassis or circuit components.

5.6 KNOB REMOVAL.

To remove the knob on a front-panel control, either to replace one that has been damaged or to replace the associated control, proceed as follows:

a. Grasp the knob firmly with the fingers, close into the panel (or the indicator dial, if applicable) and pull the knob straight, away from the panel.

CAUTION

Do not pull on the dial to remove a dial/knob assembly. Always remove the knob first.

b. Observe the position of the setscrew in the bushing with respect to any panel marking (or at the full ccw position of a continuous control).

c. Release the setscrew with an Allen wrench and pull the bushing off the shaft.

d. Remove and retain the black nylon thrust washer, behind the dial/knob assembly, as appropriate.

NOTE

To separate the bushing from the knob, if for any reason they should be combined off the instrument, drive a machine tap a turn or two into the bushing to provide sufficient grip for easy separation.

5.7 KNOB INSTALLATION.

To install a knob assembly on the control shaft:

a. Place the black nylon thrust washer over the control shaft, if appropriate.

b. Mount the bushing on the shaft, using a small slotted piece of wrapping paper as a shim for adequate panel clearance.

c. Orient the setscrew on the bushing with respect to the panel-marking index and lock the setscrew with an Allen wrench.

NOTE

Make sure that the end of the shaft does not protrude through the bushing or the knob won't seat properly.

d. Place the knob on the bushing with the retention spring opposite the setscrew.

e. Push the knob in until it bottoms and pull it slightly to check that the retention spring is seated in the groove in the bushing.

NOTE

If the retention spring in the knob comes loose, reinstall it in the interior notch with the small slit in the outer wall.

5.8 SOLDERING CONNECTIONS TO CABLE WIRES.

Use caution if it becomes necessary to unsolder or resolder a connection in the instrument, as the plastic insulation on the wires melts very easily. Hold the bare wire with pliers, near the spot to be soldered, to conduct heat away from the wire and reduce the chance of melting the insulation.

5.9. CALIBRATION.

5.9.1. Microphone Sensitivity.

The setting of the MICROPHONE SENSITIVITY LEVEL dial, for a particular microphone, is determined as described in paragraph 2.5. The internal calibration system is calibrated accurately for use when the input is derived from a low-impedance source, such as the 1560-P40 Preamplifier. When a microphone-and-cable combination is used as the source, the open-circuit sensitivity of the source must be corrected for the loss caused by the input-capacitance load of the sound-level meter. The dial should be set, then, to the corrected sensitivity and the gain adjusted accordingly (refer to paragraph 2.5).

When a 1560-P40 Preamplifier is used between the microphone and the sound-level meter, the only loss in sensitivity is that caused by the 6-pF load of the preamplifier on the microphone. This loss decreases the open-circuit sensitivity of the 1560-P7 Microphone by about 0.1 dB, as noted in paragraph 2.5. Use the corrected value in setting the MICROPHONE SENSITIVITY LEVEL dial. Also, check the calibration acoustically, using the 1562 Sound-Level Calibrator, as described in paragraph 2.6.

5.9.2. Amplifier Gain.

The gain of the sound-level meter amplifier can be calibrated from an external electrical source for a particular microphone or microphone-and-cable combination as follows: Apply a 1.0 V, 200 Hz to 1000 Hz signal to terminals #1 and #3 of the MICROPHONE connector (see Figure 5-4) through a shielded capacitor, C, that has the same capacitance as the microphone and through the 10-foot or 25-foot cable with which it is to be used. Adjust the gain (refer to the note, paragraph 2.5) so that the reading agrees with that given in Table 5-4 for the open-circuit sensitivity of the microphone.

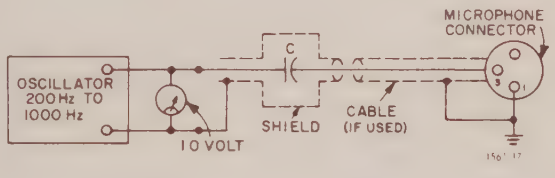


Figure 5-4. Input-circuit setup for calibrating the amplifier gain.

Table 5-4

AMPLIFIER GAIN ADJUSTMENT

Microphone Sensitivity	1561 Reading (dB)
67	141
66	140
65	139
64	138
63	137
62	136
61	135
60	134
59	133
58	132
57	131

5.10. TROUBLE ANALYSIS.

5.10.1. Test-Point Voltages.

Set the controls on the 1561 as follows:

Power switch	.LINE
WEIGHTING switch	FLAT
DECIBELS-Large dial	Fully ccw
DECIBELS-Small knob	140
CALIBRATE control	Fully cw
GAIN control	Fully cw

Apply a 1 V, 1 kHz signal from an oscillator, through a shielded cable, to the MICROPHONE input on the 1561. With all amplifier sections operating properly and the controls set as above, the meter should read approximately 150 dB. The peak-to-peak voltages to be noted at certain test points are given in Table 5-5. For the locations of the test points, refer to Figures 5-7 and 5-10.

Table 5-5

TEST VOLTAGES

Test Point	Peak-to-Peak Level
AT 111	260 mV (sinewave)
AT 116	760 mV (sinewave)
AT 122	48 mV (sinewave)
AT 127	320 mV (sinewave)
Q116, Emitter	2.8 V (sinewave)
AT 133 (OUTPUT jack)	3.8 V (sinewave)
Q 117, Collector	2.5 V

5.10.2. Transistor Replacement.

All transistors are accessible when the instrument is out of its cabinet.

Transistor Q101 is a selected field-effect transistor that must be obtained from General Radio. Transistor Q103 is selected for lower noise. The circuit noise can be checked as described in paragraph 5.10.4. Transistors Q101, Q102, and Q103 are mounted in sockets for easy replacement.

5.10.3. Transistor Voltages.

Table 5-6 lists the dc voltages between the transistor terminals and ground, under the following conditions:

DECIBELS controls (knob and dial)	fully cw
WEIGHTING switch	FLAT
Power function switch	.LINE
CALIBRATE control	Centered

No input signal.

Adjust R508 for 22 V, dc at AT510.

All voltage readings are to ground.

Use a high-impedance dc voltmeter (such as the GR 1806).

Allow a deviation of ±10% from the listed values.

5.10.4. Internal Circuit Noise.

Normally, the internal noise should not affect the readings with the DECIBELS controls set at 40 or higher. If desired, the following procedure can be used to determine the amount of noise generated in the instrument. Set the MICROPHONE SENSITIVITY LEVEL dial to -63 dB and calibrate the gain of the amplifier (refer to paragraph 2.5). Turn the CALIBRATE control fully counterclockwise and use the internal GAIN control to adjust the gain. Remove the microphone and connect together terminals #1 and #3 of the MICROPHONE input connector. Be sure terminal #2 is not connected, as this is used to supply power for a 1560-P40 Preamplifier, when used. Be sure no pickup from a magnetic field is present (refer to paragraph 2.9.2). The noise reading should not be above 24 dB with the WEIGHTING switch at C and the METER switch at FAST.

Internal noise may be caused by any transistor, but Q101, Q103, Q107 and Q108 are the more likely suspects. (Experience has shown that noise seldom develops in a transistor that was quiet previously.) If Q101 is replaced, insert a new value of R102 to give a bias voltage of -0.03 to -0.06 V, dc.

Table 5-7 gives typical signal-to-noise ratios obtained when the amplifier gain is calibrated for use with a 1560-P7 Precision Microphone having a sensitivity of -62 dB re 1 V/μbar, at the end of the 10-foot extension cable. Table 5-8 gives typical signal-to-noise ratios obtained when the amplifier gain is adjusted for use with the same microphone mounted on a Type 1560-P40 Preamplifier. The gain of the preamplifier is set at X10. The WEIGHTING switch of the sound-level meter is set at FLAT for both tables. The panel CALIBRATE control is rotated clockwise about 60°.

Table 5-6
TRANSISTOR VOLTAGES

Transistor	Terminal	DC Volts to Ground
Q101	S (AT154)	6.2
	D	20.5
Q102	E	5.8
	C	16.5
Q103	E	7.4
	C (AT111)	10.8
Q105	E (AT139)	21.0
	C (AT131)	21.8
Q107	E (AT118)	3.6
	C	18.9
Q108	E	19.5
	C	11.5
Q109	E (AT121)	20.8
	C (AT119)	21.8
Q110	E	1.15
	C	4.4
Q111	E	3.8
	C (AT122)	11.1
Q112	E	1.15
	C	4.4
Q113	E	3.9
	C	11.5
Q114	E	1.30
	C	4.8
Q115	E	4.2
	C	13.5
Q116	E	13.0
	C (AT131)	21.8
Q117	E	20.3
	C	12.0
Q118	E	20.2
	C	9.2
Q501	E	38.0
	C (AT510)	22.0
Q502	E	11.4
	C	30.5
Q503	E	11.4
	C (AT510)	22.0
Q106	E	15.5
	C	19.2
(WEIGHTING switch at EXT FILTER)		
SO101, (Load pin #2 with 10 kΩ to ground)	Pin #2	18.0
SO102 (Load pin #2 with 10 kΩ to ground)	Pin #2	18.0

Table 5-7

TYPICAL INTERNAL SIGNAL-TO-NOISE RATIOS FOR 1561-R WITH 1560-P7 PRECISION MICROPHONE AT THE END OF THE 10-FOOT CABLE (P/N 1560-2500)

				Octave-Band Noise Levels - dB Below Full Scale									
Equivalent Full-Scale Sound-Pressure Level dB	Full-Scale Reading dB	Atten. Setting dB	All Pass 20 Hz to 25 kHz	Octave-Band Center Frequencies-Hz									
				31.5	63	125	250	500	1000	2000	4000	8000	16000
40	40	30	11	26	24	25	26	26	27	26	24	22	21
50	50	40	21	36	34	35	36	36	37	36	34	32	31
60	60	50	31	46	44	45	46	46	47	46	44	42	41
70	70	60	41	56	54	55	56	56	57	56	54	52	51
80	80	70	51	66	64	65	66	66	67	66	64	62	61
90	90	80	61	76	74	75	76	76	76	76	74	72	71
100	100	90	67	83	81	82	82	83	83	81	80	78	76
110	110	100	69	85	83	83	84	85	85	83	82	80	78
120	120	110	69	85	83	83	84	85	85	83	82	80	78
130	130	120	69	85	83	83	84	85	85	83	82	80	78
140	140	130	69	85	83	83	84	85	85	83	82	80	78
150	150	140	69	85	83	83	84	85	85	83	82	80	78

Sound-level-meter amplifier gain calibrated for use with a Type 1560-P7 Microphone, with a sensitivity of -62 dB re 1 V/μbar, at end of a 10-foot extension cable. Flat response; panel CAL control approximately centered.

Table 5-8
TYPICAL INTERNAL SIGNAL-TO-NOISE RATIOS FOR 1561-R
WITH 1560-P40 PREAMPLIFIER

Equivalent Full-Scale Sound-Pressure Level dB	Full-Scale Reading dB	Atten. Setting dB	All Pass 20 Hz to 25 kHz	Octave-Band Noise Levels - dB Below Full Scale									
				Octave-Band Center Frequencies - Hz									
				31.5	63	125	250	500	1000	2000	4000	8000	16000
20	40	30	-5[1]	12	12	12	12	12	11	9	7	5	4
30	50	40	5	22	22	22	22	22	21	19	17	15	14
40	60	50	15	32	32	32	32	32	31	29	27	25	24
50	70	60	25	42	42	42	42	42	41	39	37	35	34
60	80	70	35	52	52	52	52	52	51	49	47	45	44
70	90	80	45	62	62	62	62	62	61	59	57	55	54
80	100	90	55	72	72	72	72	72	71	69	67	65	64
90	110	100	64	81	79	80	80	80	80	78	76	74	73
100	120	110	68	84	82	83	83	84	84	83	81	79	77
110	130	120	69	85	83	84	84	85	85	84	82	80	78

[1] Above full scale.

Sound-level meter amplifier gain calibrated for use with a Type 1560-P7 Microphone cartridge, with a sensitivity of -62 dB re 1 V/μbar, assembled directly on a Type 1560-P40 Preamplifier. CALIBRATE control rotated clockwise about 60° 1561-R: Flat Response. 1560-P40: 20-dB Gain.

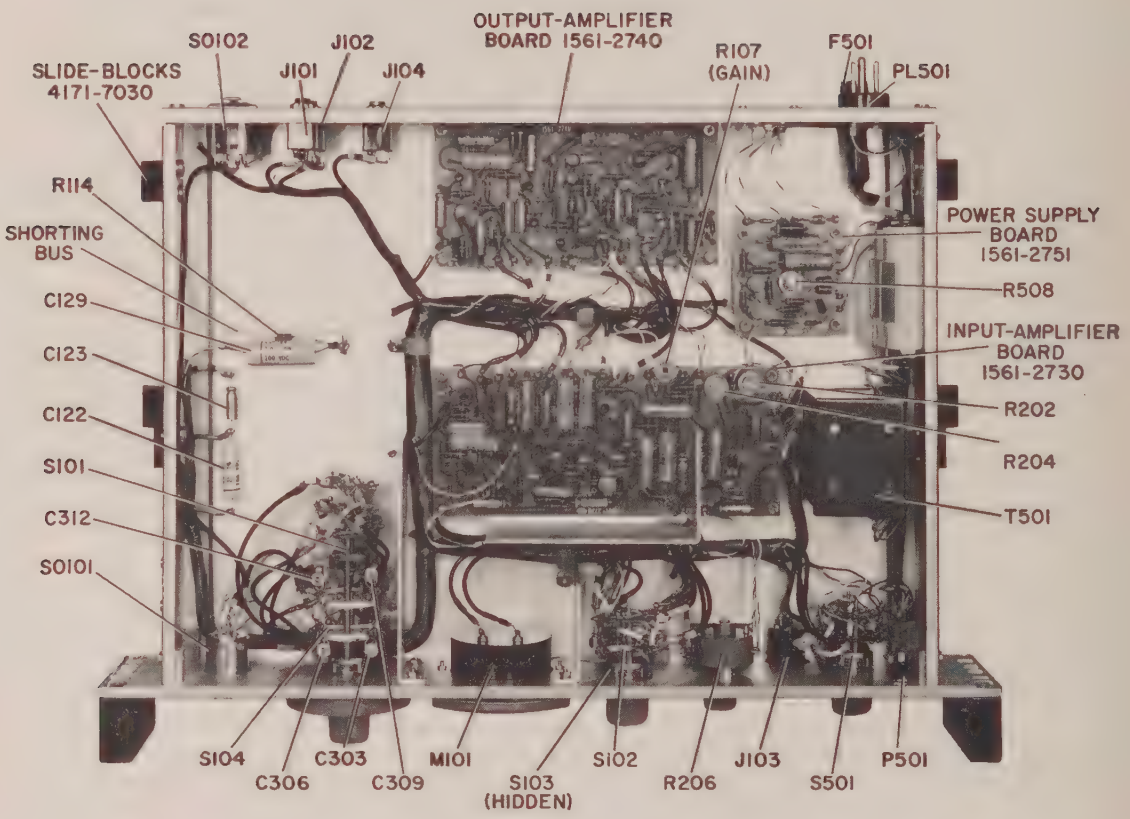


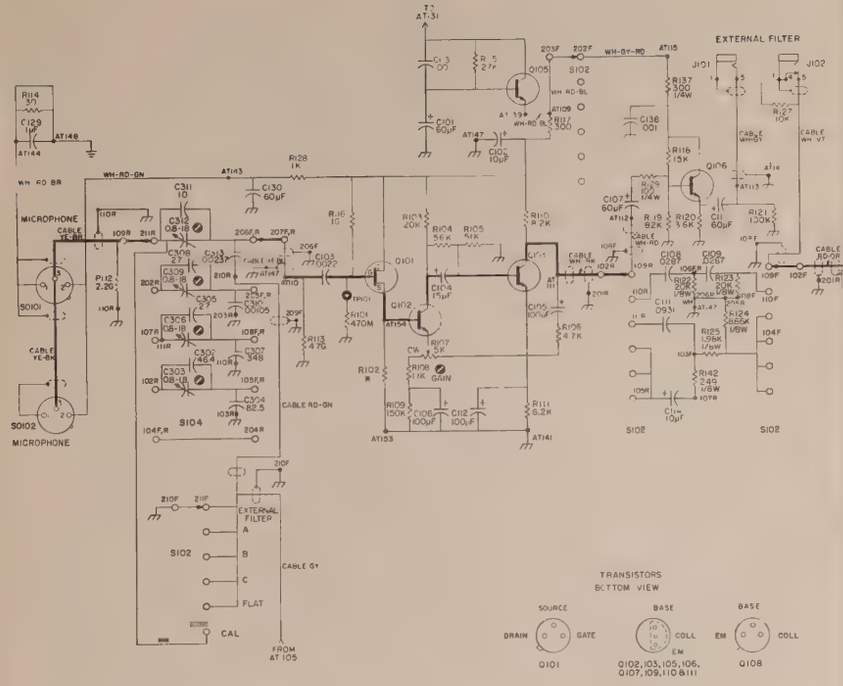
Figure 5-5. Interior view of the Sound-Level Meter.

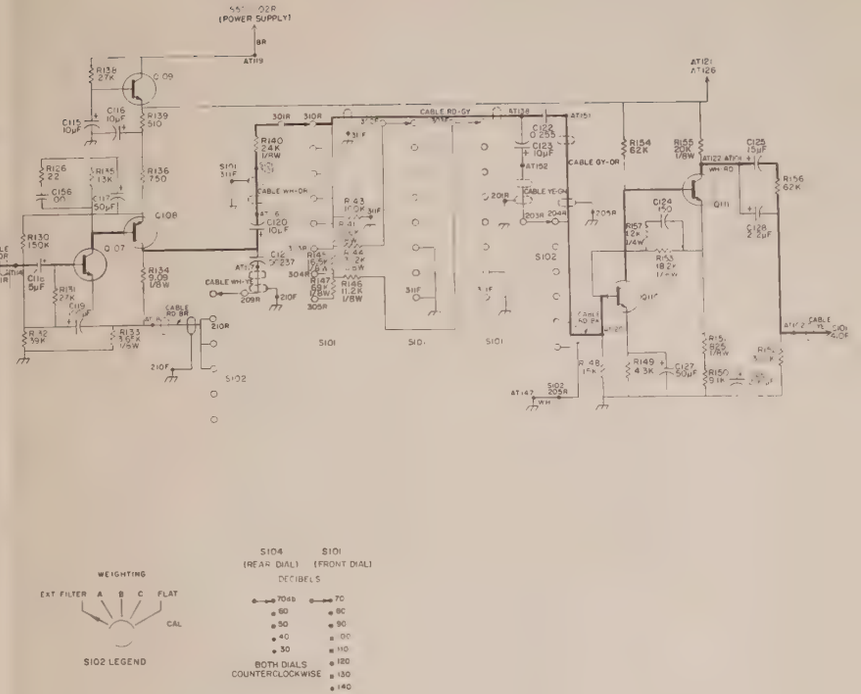
Figure 5-6. Input-amplifier etched-board assembly. Complete board is P/N 1561-2730.

NOTE

The number shown on the foil side of the board is not the part number for the complete assembly. The assembly number is given in the caption.

The dot on the foil at the transistor socket indicates the collector lead.


EXTERNAL FILTER
MICROPHONE
S102
S104
CABLE RD-GN
CABLE GY
FROM AT 105
TRANSISTORS
BOTTOM VIEW
SOURCE
DRAIN
GATE
BASE
COLL
EM
Q101
Q102,103,105,106, Q107,109,110 &111
Q108
NOTE UNLESS SPECIFIED
1 POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2 CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3 REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4 RESISTORS 1/2 WATT
5 RESISTANCE IN OHMS K=1000 OHMS M=1 MEGOHM
6 CAPACITANCE VALUES ONE AND OVER IN MICROFARADS, LESS THAN ONE IN MICROFARADS
7 KNOB CONTROL
8 SCREWDRIVER CONTROL
9 AT ANCHOR TERMINAL
10 TP TEST POINT
= CIRCUIT GROUND
= CHASSIS GROUND
S104 NOTE
CONTINUITY BETWEEN SECTIONS 1 & 2 IS ACCOMPLISHED BY CONNECTION OF TERMINALS 104F,R TO 204R. THIS CONNECTION IS NOT SHOWN ON SCHEMATIC



Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

Figure 5-7. Partial schematic circuit diagram of the Type 1561-R Precision Sound-Level Meter. (See also Figures 5-9 and 5-11).

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

Code	Manufacturer
00192	Jones Mfg. Co, Chicago, Illinois
00194	Welsco Electronics Corp, L.A., Calif.
00434	Schweber Electronics, Westburg, L.I., N.Y.
00656	Aerovox Corp, New Bedford, Mass.
01009	Alden Products Co, Brockton, Mass.
01121	Allen-Bradley, Co, Milwaukee, Wisc.
01295	Texas Instruments, Inc, Dallas, Texas
02114	Ferroxcube Corp, Saugertles, N.Y. 12477
02606	Fenwal Lab Inc, Morton Grove, Ill.
02660	Amphenol Electron Corp, Broadview, Ill.
02768	Fastex, Des Plaines, Ill. 60016
03508	G.E. Semicon Prod, Syracuse, N.Y. 13201
03636	Graybunne, Yonkers, N.Y. 10701
03888	Pyrofilm Resistor Co, Cedar Knolls, N.J.
03911	Clairex Corp, New York, N.Y. 10001
04009	Arrow-Hart & Hegeman, Hartford, Conn. 06106
04713	Motorola, Phoenix, Ariz. 85008
05170	Engr'd Electronics, Santa Ana, Calif. 92702
05624	Barber-Colman Co, Rockford, Ill. 61101
05820	Wakefield Eng, Inc, Wakefield, Mass. 01880
07126	Digitron Co, Pasadena, Calif.
07127	Eagle Signal (E.W. Bliss Co), Baraboo, Wisc.
07261	Avnet Corp, Culver City, Calif. 90230
07263	Fairchild Camera, Mountain View, Calif.
07387	Stircher Corp, No. Los Angeles, Calif.
07595	Amer Semicond, Arlington Hts. Ill. 60004
07828	Bodine Corp, Bridgeport, Conn. 06605
07829	Bodine Electric Co, Chicago, Ill. 60618
07910	Cont Device Corp, Hawthorne, Calif.
07983	State Labs Inc, N.Y., N.Y. 10003
07999	Borg Inst., Delavan, Wisc. 53115
08730	Vemaline Prod Co, Franklin Lakes, N.J.
09213	G.E. Semiconductor, Buffalo, N.Y.
09408	Star-Tronics Inc, Georgetown, Mass. 01830
09823	Burgess Battery Co, Freeport, Ill.
09922	Burndy Corp, Norwalk, Conn. 06852
11236	C.T.S. of Berne, Inc, Berne, Ind. 46711
11599	Chandler Evans Corp, W. Hartford, Conn.
12040	National Semiconductor, Danbury, Conn.
12498	Crystalonics, Cambridge, Mass. 02140
12672	RCA, Woodbridge, N.J.
12697	Clarostat Mfg Co, Inc, Dover, N.H. 03820
12954	Dickson Electronics, Scottsdale, Ariz.
13327	Solitron Devices, Tappan, N.Y. 10983
14433	ITT Semiconductors, W.Palm Beach, Fla.
14655	Cornell-Dubilier Electric Co, Newark, N.J.
14674	Corning Glass Works, Corning, N.Y.
14936	General Instrument Corp, Hicksville, N.Y.
15238	ITT, Semiconductor Div, Lawrence, Mass.
15605	Cutlet-Hammer Inc, Milwaukee, Wisc. 53233
16037	Spruce Pine Mica Co, Spruce Pine, N.C.
17771	Singer Co, Diehl Div, Somerville, N.J.
19396	Illinois Tool Works, Pakton Div, Chicago, Ill.
19644	LRC Electronics, Horseheads, N.Y.
19701	Electra Mfg Co, Independence, Kansas 67301
21335	Fafnir Bearing Co, New Briton, Conn.
22753	UID Electronics Corp, Hollywood, Fla.
23342	Avnet Electronics Corp, Franklin Park, Ill.
24446	G.E., Schenectady, N.Y. 12305
24454	G.E., Electronics Comp, Syracuse, N.Y.
24455	G.E. (Lamp Div), Nela Park, Cleveland, Ohio
24655	General Radio Co, W. Concord, Mass. 01781
26806	American Zettlet Inc, Costa Mesa, Calif.
28520	Heyman Mfg Co, Kenilworth, N.J.
28959	Hoffman Electronics Corp, El Monte, Calif.
30874	I.B.M, Armonk, New York
32001	Jensen Mfg. Co, Chicago, Ill. 60638
33173	G.E. Comp, Owensboro, Ky. 42301
35929	Constanta Co, Mont. 19, Que.
37942	P.R. Mallory & Co Inc, Indianapolis, Ind.
38443	Marlin-Rockwell Corp, Jamestown, N.Y.
40931	Honeywell Inc, Minneapolis, Minn. 55408
42190	Muter Co, Chicago, Ill. 60638
42498	National Co, Inc, Melrose, Mass. 02176
43991	Norma-Hoffman, Stanford, Conn. 06904
49671	RCA, New York, N.Y. 10020
49956	Raytheon Mfg Co, Waltham, Mass. 02154
53021	Sangamo Electric Co, Springfield, Ill. 62705
54294	Shallcross Mfg Co, Selma, N.C.
54715	Shure Brothers, Inc, Evanston, Ill.
56289	Sprague Electric Co, N. Adams, Mass.
59730	Thomas and Betts Co, Elizabeth, N.J. 07207
59875	TRW Inc, (Accessories Div), Cleveland, Ohio
60399	Torrington Mfg Co, Torrington, Conn.
61637	Union Carbide Corp, New York, N.Y. 10017
61864	United-Carr Fastener Corp, Boston, Mass.
62060	Victoreen Instrument Co, Inc, Cleveland, O.
63743	Ward Leonard Electric Co, Mt. Vernon, N.Y.
65083	Westinghouse (Lamp Div), Bloomfield, N.J.
65092	Weston Instruments, Newark, N.J.
70485	Atlantic-Indis Rubber, Chicago, Ill. 60607
70563	Amperite Co, Union City, N.J. 07087
70903	Belden Mfg Co, Chicago, Ill. 60644
71126	Bronson, Homer D, Co, Beacon Falls, Conn.
71294	Canfield, H.O. Co, Clifton Forge, Va. 24422
71400	Bussman (McGraw Edison), St. Louis, Mo.
71468	ITT Cannon Elec, L.A., Calif. 90031
71590	Centralab, Inc, Milwaukee, Wisc. 53212
71666	Continental Carbon Co, Inc, New York, N.Y.
71707	Coto Coil Co Inc, Providence, R.I.
71744	Chicago Miniature Lamp Works, Chicago, Ill.
71785	Cinch Mfg Co, Chicago, Ill. 60624
71823	Darnell Corp, Ltd, Downey, Calif. 90241
72136	Electro Motive Mfg Co, Wilmington, Conn.
72259	Nytronics Inc, Berkeley Heights, N.J. 07922
72619	Dialight Co, Brooklyn, N.Y. 11237
72699	General Instr Corp, Newark, N.J. 07104
72765	Drake Mfg Co, Chicago, Ill. 60656
72825	Hugh H. Eby Inc, Philadelphia, Penn. 19144
72962	Elastic Stop Nut Corp, Union, N.J. 07083
72982	Erie Technological Products Inc, Erie, Penn.
73138	Beckman Inc, Fullerton, Calif. 92634
73445	Amperex Electronics Co, Hicksville, N.Y.
73559	Carling Electric Co, W.Hartford, Conn.
73690	Elco Resistor Co, New York, N.Y.
73899	JFD Electronics Corp, Brooklyn, N.Y.
74193	Heinemann Electric Co, Trenton, N.J.
74861	Industrial Condenser Corp, Chicago, Ill.
74970	E.F. Johnson Co, Waseca, Minn. 56093
75042	IRC Inc, Philadelphia, Penn. 19108
75382	Kulka Electric Corp, Mt. Vernon, N.Y.
75491	Lafayette Industrial Electronics, Jamica, N.Y.
75608	Linden and Co, Providence, R.I.
75915	Littelfuse, Inc, Des Plaines, Ill. 60016
76005	Lord Mfg Co, Erie, Penn. 16512
76149	Mallory Electric Corp, Detroit, Mich. 48204
76487	James Millen Mfg Co, Malden, Mass. 02148
76545	Mueller Electric Co, Cleveland, Ohio 44114
76684	National Tube Co, Pittsburg, Penn.
76854	Oak Mfg Co, Crystal Lake, Ill.
77147	Patton MacGuyer Co, Providence, R.I.
77166	Pass-Seymour, Syracuse, N.Y.
77263	Pierce Roberts Rubber Co, Trenton, N.J.
77339	Positive Lockwasher Co, Newark, N.J.
77542	Ray-O-Vac Co, Madison, Wisc.
77630	TRW, Electronic Comp, Camden, N.J. 08103
77638	General Instruments Corp, Brooklyn, N.Y.
78189	Shakeproof (Ill. Tool Works), Elgin, Ill. 60120
78277	Sigma Instruments Inc, S.Braintree, Mass.
78488	Stackpole Carbon Co, St. Marys, Penn.
78553	Tinnerman Products, Inc, Cleveland, Ohio
79089	RCA, Rec Tube & Semicond, Harrison, N.J.
79725	Wiremold Co, Hartford, Conn. 06110
79963	Zierick Mfg Co, New Rochelle, N.Y.
80030	Prestole Fastener, Toledo, Ohio
80048	Vickers Inc, St. Louis, Mo.
80131	Electronic Industries Assoc, Washington, D.C.
80183	Sprague Products Co, No. Adams, Mass.
80211	Motorola Inc, Franklin Park, Ill. 60131
80258	Standard Oil Co, Lafeyette, Ind.
80294	Bourns Inc, Riverside, Calif. 92506
80431	Air Filter Corp, Milwaukee, Wisc. 53218
80583	Hammarlund Co, Inc, New York, N.Y.
80740	Beckman Instruments, Inc, Fullerton, Calif.
81030	International Instrument, Orange, Conn.
81073	Grayhill Inc, LaGrange, Ill. 60525
81143	Isolantite Mfg Corp, Stirling, N.J. 07980
81349	Military Specifications
81350	Joint Army-Navy Specifications
81751	Columbus Electronics Corp, Yonkers, N.Y.
81831	Filtron Co, Flushing, L.I., N.Y. 11354
81840	Ledex Inc, Dayton, Ohio 45402
81860	Berry-Wright Corp, Watertown, Mass.
82219	Sylvania Elec Prod, Emporium, Penn.
82273	Indiana Pattern & Model Works, LaPort, Ind.
82389	Switchcraft Inc, Chicago, Ill. 60630
82647	Metals & Controls Inc, Attleboro, Mass.
82807	Milwaukee Resistor Co, Milwaukee, Wisc.
83033	Meissner Mfg. (Maguire Ind) Mt. Carmel, Ill.
83058	Carr Fastener Co, Cambridge, Mass.
83186	Victory Engineering, Springfield, N.J. 07081
83361	Bearing Specialty Co, San Francisco, Calif.
83587	Solar Electric Corp, Warren, Penn.
83740	Union Carbide Corp, New York, N.Y. 10017
83781	National Electronics Inc, Geneva, Ill.
84411	TRW Capacitor Div, Ogallala, Nebr.
84835	Lehigh Metal Prods, Cambridge, Mass. 02140
84971	TA Mfg Corp, Los Angeles, Calif.
86577	Precision Metal Prods, Stoneham, Mass. 02180
86684	RCA (Elect. Comp & Dev), Harrison, N.J.
86687	REC Corp, New Rochelle, N.Y. 10801
86800	Cont Electronics Corp, Brooklyn, N.Y. 11222
88140	Cutler-Hammer Inc, Lincoln, Ill.
88219	Gould Nat. Batteries Inc, Trenton, N.J.
88419	Cornell-Dubilier, Fuquay-Varina, N.C.
88627	K & G Mfg Co, New York, N.Y.
89462	Holtzer-Cabot Corp, Boston, Mass.
89665	United Transformer Co, Chicago, Ill.
90201	Mallory Capacitor Co, Indianapolis, Ind.
90750	Westinghouse Electric Corp, Boston, Mass.
90952	Hardware Products Co, Reading, Penn. 19602
91032	Continental Wire Corp, York, Penn. 17405
91146	ITT (Cannon Electric Inc), Salem, Mass.
91293	Johanson Mfg Co, Boonton, N.J. 07005
91506	Augat Inc, Attleboro, Mass. 02703
91598	Chandler Co, Wethersfield, Conn. 06109
91637	Dale Electronics Inc, Columbus, Nebr.
91662	Elco Corp, Willow Grove, Penn.
91719	General Instruments, Inc, Dallas, Texas
91929	Honeywell Inc, Freeport, Ill.
92519	Electra Insul Corp, Woodside, L.I., N.Y.
92678	E.G.&G., Boston, Mass.
93332	Sylvania Elect Prods, Inc, Woburn, Mass.
93916	Cramer Products Co, New York, N.Y. 10013
94144	Raytheon Co, Components Div, Quincy, Mass.
94154	Tung Sol Electric Inc, Newark, N.J.
95076	Garde Mfg Co, Cumberland, R.I.
95121	Quality Components Inc, St. Mary's, Penn.
95146	Alco Electronics Mfg Co, Lawrence, Mass.
95238	Continental Connector Corp, Woodside, N.Y.
95275	Vitramon, Inc, Bridgeport, Conn.
96354	Methode Mfg Co, Chicago, Ill.
96412	General Electric Co, Schenectady, N.Y.
96794	Anaconda Amer Brass Co, Torrington, Conn.
96095	Hi-Q Div. of Aerovox Corp, Orlean, N.Y.
96214	Texas Instruments Inc, Dallas, Texas 75209
96256	Thordarson-Meissner, Mt. Carmel, Ill.
96341	Microwave Associates Inc, Burlington, Mass.
96791	Amphenol Corp, Jonesville, Wisc, 53545
96906	Military Standards
98291	Sealectro Corp, Mamaroneck, N.Y. 10544
98474	Compar Inc, Burlingame, Calif.
98821	North Hills Electronics Inc, Glen Cove, N.Y.
99180	Tranitron Electronics Corp, Melrose, Mass.
99313	Varian, Palo Alto, Calif. 94303
99378	Atlee Corp, Winchester, Mass. 01890
99800	Delevan Electronics Corp, E. Aurora, N.Y.

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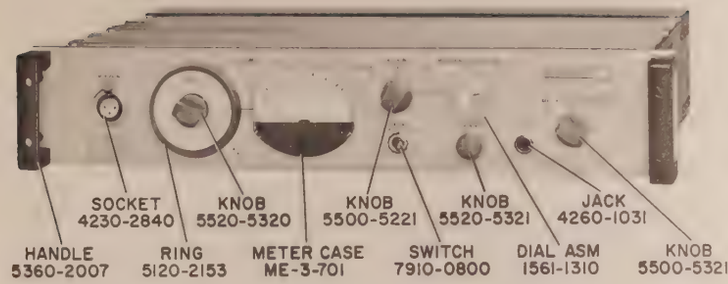


MISCELLANEOUS PARTS LIST

Description	*GR Part No.*	*FMC*	*Mfg. Part No.*	*Fed. Stock No.*
Dial Assembly, DECIBELS	1561-1070	24655	1561-1070	
Dial Assembly, MICROPHONE SENSITIVITY LEVEL	1561-1080	24655	1561-1080	
Rackable Cabinet Assembly	4174-4003	24655	4174-4003	
Power Cord	4200-9622	24655	4200-9622	6150-968-0081
Ring, (outer) DECIBEL Dial	5120-2153	24655	5120-2153	
Fuse, Slo-Blo, 1/10 A	5330-0400	71400	MDL, 0.1 Amp.	5920-356-2185
Handle	5360-2007	24655	5360-2007	
Knob, WEIGHTING	5500-5321	24655	5500-5321	
Knob, power function switch	5500-5321	24655	5500-5321	
Knob, asm on DECIBEL dial	5520-5320	24655	5520-5320	
Knob Assembly, CALIBRATE	5520-5221	24655	5520-5221	
Lamp Holder	5600-1023	24655	5600-1023	
Etched Circuits				
Etched Circuit Assembly	1561-2730	24655	1561-2730	
Etched Circuit Assembly	1561-2740	24655	1561-2740	
Power Supply Circuit Assembly	1561-2751	24655	1561-2751	
Meter case, clear plastic	ME-3-701	24655		

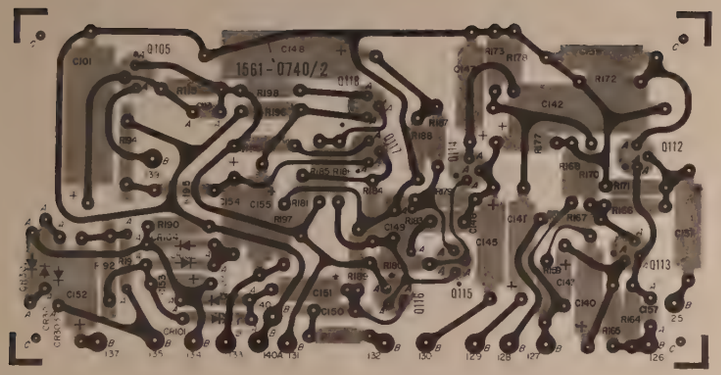
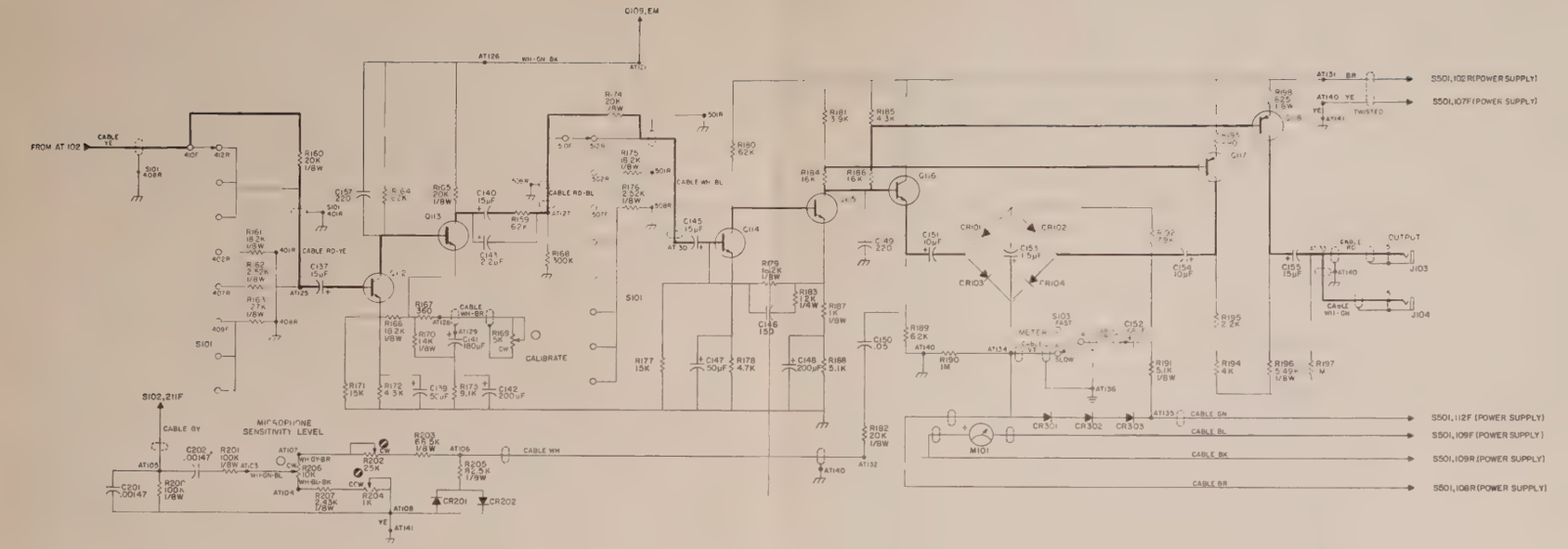


Figure 5-8. Output-amplifier etched-board assembly. Complete board is P/N 1561-2740.

NOTE

The number shown on the foil side of the board is not the part number for the complete assembly. The assembly number is given in the caption.

The dot on the foil at the transistor socket indicates the collector lead.



NOTE UNLESS SPECIFIED

1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE.
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK.
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM.
4. RESISTORS 1/2 WATT
5. RESISTANCE IN OHMS K 1000 OHMS M 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN MICROFARADS, LESS THAN ONE IN MICROFARADS
7. KNOB CONTROL
8. SCREWDRIVER CONTROL
9. AT ANCHOR TERMINAL
10. TP TEST POINT

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

Figure 5-9. Partial schematic circuit diagram of the Type 1561-R Precision Sound-Level Meter. (See also Figures 5-7 and 5-11.)

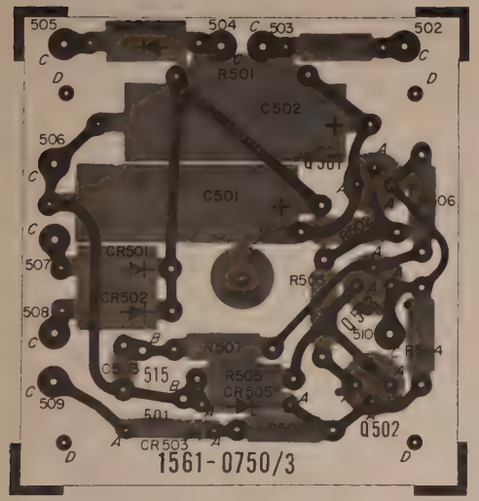
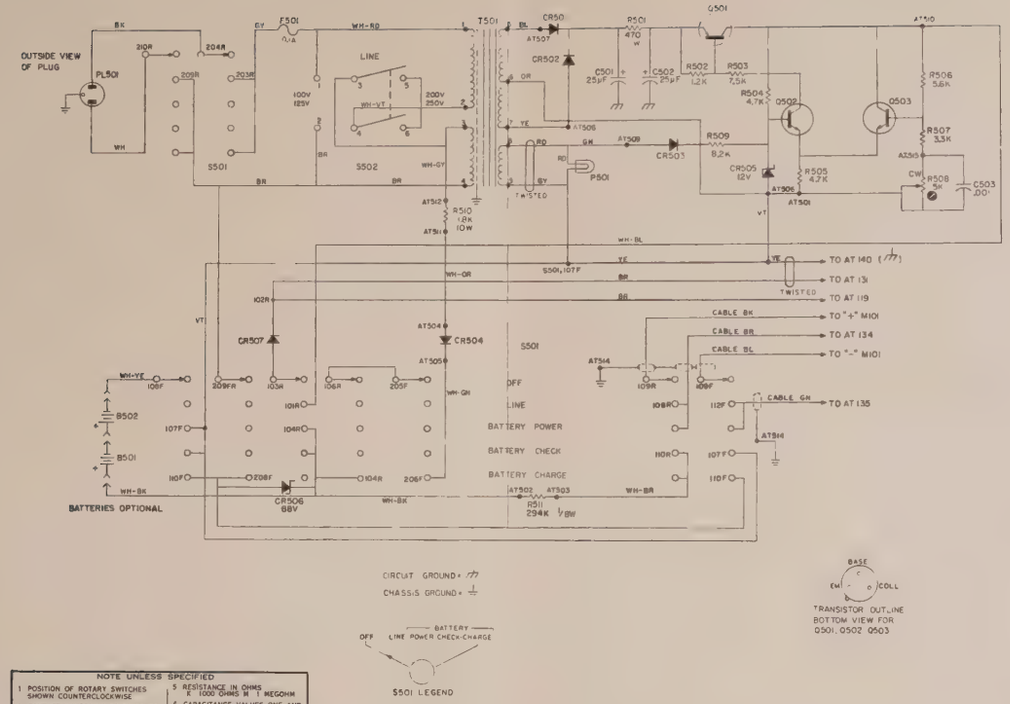


Figure 5-10. Power-supply etched-board assembly. Complete board is P/N 1561-2751.

NOTE

The number shown on the foil side of the board is not the part number for the complete assembly. The assembly number is given in the caption.

The dot on the foil at the transistor socket indicates the collector lead.



NOTE UNLESS SPECIFIED

1. POSITION OF ROTARY SWITCHES SHOWN COUNTERCLOCKWISE
2. CONTACT NUMBERING OF SWITCHES EXPLAINED ON SEPARATE SHEET SUPPLIED IN INSTRUCTION BOOK
3. REFER TO SERVICE NOTES IN INSTRUCTION BOOK FOR VOLTAGES APPEARING ON DIAGRAM
4. RESISTORS 1/2 WATT
5. RESISTANCE IN OHMS IF 1000 OHMS M 1 MEGOHM
6. CAPACITANCE VALUES ONE AND OVER IN PICOFARADS LESS THAN ONE IN MICROFARADS
7. KNOB CONTROL
8. SCREWDRIVER CONTROL
9. AT ANCHOR TERMINAL
10. TP TEST POINT

Rotary switch sections are shown as viewed from the panel end of the shaft. The first digit of the contact number refers to the section. The section nearest the panel is 1, the next section back is 2, etc. The next two digits refer to the contact. Contact 01 is the first position clockwise from a strut screw (usually the screw above the locating key), and the other contacts are numbered sequentially (02, 03, 04, etc), proceeding clockwise around the section. A suffix F or R indicates that the contact is on the front or rear of the section, respectively.

Figure 5-11. Schematic circuit diagram for the power supply of the Type 1561-R Precision Sound-Level Meter.

PARTS LIST

Ref. Desig.	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
CAPACITORS					
C101	Electrolytic, 60 µF +100-10% 25 V	4450-2900	56289	D17872	5910-799-9280
C102	Electrolytic, 10 µF +100-10% 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C103	Mica, 0.0022 µF ±10% 300 V	4570-1300	14655	5A, 0.0022 µF ±10%	
C104	Electrolytic, 15 µF +100-10% 15 V	4450-3700	37942	TT, 15 µF +100-10%	
C105	Electrolytic, 100 µF +100-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C106	Electrolytic, 100 µF +100-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C107	Electrolytic, 60 µF +100-10% 25 V	4450-2900	56289	D17872	5910-799-9280
C108	Plastic, 0.0287 µF ±2% 100 V	4860-7848	84411	663UW, 0.0287 µF ±2%	
C109	Plastic, 0.0287 µF ±2% 100 V	4860-7848	84411	663UW, 0.0287 µF ±2%	
C110	Electrolytic, 60 µF +100-10% 25 V	4450-2900	56289	D17872	5910-799-9280
C111	Plastic, 0.0931 µF ±1% 100 V	4860-7884	84411	663UW, 0.0931 µF ±1%	
C112	Electrolytic, 100 µF +100-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C113	Ceramic, 0.001 µF ±10% 500 V	4405-2108	72982	801, 0.001 µF ±10%	
C114	Electrolytic, 10 µF ±20% 20 V	4450-5100	56289	150D106X0020B2	5910-855-6343
C115	Electrolytic, 10 µF +100-10% 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C116	Electrolytic, 10 µF +100-10% 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C117	Electrolytic, 50 µF +100-10% 3 V	4450-5590	37942	TT, 50 µF 3 V	
C118	Electrolytic, 5 µF +100-10% 50 V	4450-3900	37942	2040595S9C10X3	5910-448-5527
C119	Electrolytic, 100 µF +100-10% 15 V	4450-2800	56289	D17872	5910-034-5368
C120	Electrolytic, 10 µF +100-10% 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C121	Mica, 0.00237 µF ±2% 300 V	4590-0871	14655	5A, 0.00237 µF ±2%	
C122	Plastic, 0.255 µF ±2% 100 V	4860-7978	84411	663UW, 0.255 µF ±2%	
C123	Electrolytic 10 µF +100-10% 25 V	4450-3800	56289	30D106G025BB4M1	5910-952-8658
C124	Mica, 150 pF ±10% 500 V	4700-0440	14655	22A5T15, 150 pF ±10%	
C125	Electrolytic, 15 µF +100-10% 15 V	4450-3700	37942	TT, 15 µF +100-10%	
C126	Electrolytic, 200 µF +100-10% 6 V	4450-2610	37942	TT, 200 µF +100-10%	5910-945-1836
C127	Electrolytic, 50 µF +100-10% 3 V	4450-5590	37942	TT, 50 µF +100-10%	
C128	Electrolytic, 2.2 µF ±20% 20 V	4450-4500	56289	150D225X0020A2	5910-976-4604
C129	Plastic, 1 µF ±10% 100 V	4860-8274	84411	663UW, 1 µF ±10%	
C137	Electrolytic, 15 µF +100-10% 15 V	4450-3700	37942	TT, 15 µF +100-10%	
C139	Electrolytic, 50 µF +100-10% 3 V	4450-5590	37942	TT, 50 µF +100-10%	
C140	Electrolytic, 15 µF +100-10% 15 V	4450-3700	37942	TT, 15 µF +100-10%	
C141	Electrolytic, 180 µF ±20% 6 V	4450-5617	56289	150D187X0006R2	
C142	Electrolytic, 200 µF +100-10% 6 V	4450-2610	37942	TT, 200 µF +100-10%	5910-945-1836
C143	Electrolytic, 2.2 µF ±20% 20 V	4450-4500	56289	150D225X0020A2	5910-976-4604
C145	Electrolytic, 15 µF +100-10% 15 V	4450-3700	37942	TT, 15 µF 15 V	
C146	Mica, 150 pF ±10% 500 V	4700-0440	14655	22A5T15, 150 pF ±10%	
C147	Electrolytic, 50 µF +100-10% 3 V	4450-5590	37942	TT, 50 µF 3 V	
C148	Electrolytic, 200 µF +100-10% 6 V	4450-2610	37942	TT, 200 µF +100-10%	5910-945-1836
C149	Mica, 220 pF ±10% 500 V	4700-0518	14655	22A, 220 pF ±10%	
C150	Ceramic, 0.05 µF +80-20% 50 V	4403-3500	01121	40-503W	5910-883-7321
C151	Electrolytic, 10 µF ±20% 20 V	4450-5100	56289	150D106X0020B2	5910-855-6343
C152	Electrolytic, 50 µF ±10% 15 V	4450-5630	56289	150D686X9015R	
C153	Electrolytic, 1.5 µF ±20% 20 V	4450-4400	56289	150D155X0020A2	5910-670-7525
C154	Electrolytic, 10 µF ±20% 20 V	4450-5100	56289	150D106X0020B2	5910-855-6343
C155	Electrolytic, 15 µF +100-10% 15 V	4450-3700	37942	TT, 15 µF +100-10%	
C156	Ceramic, 0.001 µF ±10% 500 V	4405-2108	72982	801, 0.001 µF ±10%	
C157	Ceramic, 220 pF ±10% 500 V	4404-1228	72982	831, 220 pF ±10%	
C201	Mica, 0.00147 µF ±2% 100 V	4700-0687	14655	22A, 0.00147 µF ±2%	
C202	Mica, 0.00147 µF ±2% 100 V	4700-0687	14655	22A, 0.00147 µF ±2%	
C302	Mica, 46.4 pF ±2% 500 V	4700-0680	14655	22A, 46.4 pF ±2%	
C303	Trimmer, 0.8-18 pF	4910-1105	24655	4910-1105	
C304	Mica, 82.5 pF ±2% 500 V	4700-0384	14655	22A, 82.5 pF ±2%	
C305	Mica, 28.7 pF ±2% 500 V	4700-0238	14655	22A5Q27KD	
C306	Trimmer, 0.8-18 pF	4910-1105	24655	4910-1105	
C307	Mica, 348 pF ±2% 500 V	4700-0539	14655	22A, 348 pF ±2%	
C308	Mica, 28.7 pF ±2% 500 V	4700-0238	14655	22A5Q27KD	
C309	Trimmer, 0.8-18 pF	4910-1105	24655	4910-1105	
C310	Mica, 0.00105 µF 100 V	4700-0688	14655	22A, 0.00105 µF 100 V	
C311	Ceramic, 10 pF ±10% 500 V	4400-1100	78488	CA, 10 pF ±10%	5910-061-8236
C312	Trimmer, 0.8-18 pF	4910-1105	24655	4910-1105	
C313	Mica, 0.00237 µF ±2% 300 V	4590-0871	14655	5A, 0.00237 µF ±2%	
C501	Electrolytic, 25 µF +100-10% 50 V	4450-3000	56289	D33883	5910-799-9285
C502	Electrolytic, 25 µF +100-10% 50 V	4450-3000	56289	D33883	5910-799-9285
C503	Ceramic, 0.001 µF ±10% 500 V	4405-2108	72982	801, 0.001 µF ±10%	

PARTS LIST (cont.)

Ref. Desig.	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
RESISTORS					
R101	Composition, 2.2 GΩ ±20% 1/2 W	6100-8228	01121	EB, 2.2 GΩ ±20%	
R102	Val. Det. By Lab 1/2 W				
R103	Composition, 20 kΩ ±5% 1/2 W	6100-3205	01121	RC20GF203J	5905-192-0649
R104	Composition, 56 kΩ ±5% 1/2 W	6100-3565	01121	RC20GF563J	5905-171-1986
R105	Composition, 51 kΩ ±5% 1/2 W	6100-3515	01121	RC20GF513J	5905-279-3496
R106	Composition, 4.7 kΩ ±5% 1/2 W	6100-2475	01121	RC20GF472J	5905-279-3504
R107	Potentiometer, 5 kΩ ±10%	6050-1700	12697	43WX, 5 kΩ	5905-794-3859
R108	Composition, 1.1 kΩ ±5% 1/2 W	6100-2115	01121	RC20GF112J	5905-279-3508
R109	Composition, 150 kΩ ±5% 1/2 W	6100-4155	01121	RC20GF154J	5905-279-2522
R110	Composition, 8.2 kΩ ±5% 1/2 W	6100-2825	01121	RC20GF822J	5905-299-1971
R111	Composition, 6.2 kΩ ±5% 1/2 W	6100-2625	01121	RC20GF622J	5905-279-2673
R112	Composition, 2.2 GΩ ±20% 1/2 W	6100-8228	01121	EB, 2.2 GΩ ±20%	
R113	Composition, 4.7 GΩ ±20% 1/2 W	6100-8478	01121	EB, 4.7 GΩ ±20%	
R114	Composition, 30 Ω ±5% 1/2 W	6100-0305	01121	RC20GF301J	5905-279-3518
R115	Composition, 27 kΩ ±5% 1/2 W	6100-3275	01121	RC20GF273J	5905-279-3499
R116	Composition, 4.7 GΩ ±20% 1/2 W	6100-8478	01121	EB, 4.7 GΩ ±20%	
R117	Composition, 300 Ω ±5% 1/2 W	6100-1305	01121	RC20GF301J	5905-279-5481
R118	Composition, 11 kΩ ±5% 1/2 W	6100-3115	01121	RC20GF113J	5905-279-2667
R119	Composition, 82 kΩ ±5% 1/2 W	6100-3825	01121	RC20GF823J	5905-279-3494
R120	Composition, 3.6 kΩ ±5% 1/2 W	6100-2365	01121	RC20GF362J	5905-171-2001
R121	Composition, 100 kΩ ±5% 1/2 W	6100-4105	01121	RC20GF104J	5905-195-6761
R122	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-702-5971
R123	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-702-5971
R124	Film, 8.66 kΩ ±1% 1/8 W	6250-1866	75042	CEA, 8.66 kΩ ±1%	5905-755-8130
R125	Film, 2.23 kΩ ±1/2% 1/8 W	6251-1223	75042	CEA-TO, 2.23 kΩ ±1/2%	
R126	Composition, 22 Ω ±5% 1/4 W	6099-0225	75042	BTS, 22 Ω ±5%	5905-279-5459
R127	Composition, 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	
R130	Composition, 150 kΩ ±5% 1/2 W	6100-4155	01121	RC20GF154J	5905-279-2522
R131	Composition, 27 kΩ ±5% 1/2 W	6100-3275	01121	RC20GF273J	5905-279-3499
R132	Composition, 39 kΩ ±5% 1/2 W	6100-3395	01121	RC20GF393J	5905-279-3497
R133	Film, 3.65 kΩ ±1% 1/8 W	6250-1365	75042	CEA, 3.65 kΩ ±1%	
R134	Film, 9.09 kΩ ±1% 1/8 W	6250-1909	75042	CEA, 9.09 kΩ ±1%	5905-655-3167
R135	Composition, 13 kΩ ±5% 1/2 W	6100-3135	01121	RC20GF133J	5905-279-2669
R136	750 Ω ±5% 1/2 W	6100-1755	01121	RC20GF751J	5905-195-9481
R138	Composition, 27 kΩ ±5% 1/2 W	6100-3275	01121	RC20GF273J	5905-279-3499
R139	Composition, 510 Ω ±5% 1/2 W	6100-1515	01121	RC20GF511J	5905-279-3511
R140	Film, 25 kΩ ±1/2% 1/8 W	6251-2240	75042	CEA-TO, 24 kΩ ±1/2%	
R141	Film, 10.6 kΩ ±1/2% 1/8 W	6251-2106	75042	CEA-TO, 10.6 kΩ ±1/2%	
R143	Composition, 100 kΩ ±5% 1/2 W	6100-4105	01121	RC20GF104J	5905-195-6761
R144	Film, 31.2 kΩ ±1/2% 1/2 W	6251-2312	75042	CEA-TO, 31.2 kΩ ±1/2%	
R145	Film, 16.5 kΩ ±1% 1/8 W	6250-2165	75042	CEA, 16.5 kΩ ±1%	5905-892-6923
R146	Film, 11.2 kΩ ±1% 1/8 W	6250-2112	75042	CEA, 11.2 kΩ ±1%	
R147	Film, 69 kΩ ±1/2% 1/8 W	6251-2690	75042	CEA-TO, 69 kΩ ±1/2%	
R148	Composition, 15 kΩ ±5% 1/2 W	6100-3155	01121	RC20GF153J	
R149	Composition, 4.3 kΩ ±5% 1/2 W	6100-2435	01121	RC20GF432J	5905-279-2616
R150	Composition, 9.1 kΩ ±5% 1/2 W	6100-2915	01121	RC20GF912J	5905-257-0935
R151	Film, 825 Ω ±1% 1/8 W	6250-0825	75042	CEA, 825 Ω ±1%	5905-249-4200
R152	Composition, 300 kΩ ±5% 1/2 W	6100-4305	01121	RC20GF304J	5905-702-4172
R153	Film, 18.2 kΩ ±1% 1/8 W	6250-2182	75042	CEA, 18.2 kΩ ±1%	5905-185-6859
R154	Composition, 62 kΩ ±5% 1/2 W	6100-3625	01121	RC20GF623J	5905-686-3373
R155	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-249-3656
R156	Composition, 62 kΩ ±5% 1/2 W	6100-3625	01121	RC20GF623J	5905-702-5971
R157	Composition, 1.2 kΩ ±10% 1/4 W	6099-2129	75042	BTS, 1.2 kΩ ±10%	5905-249-3656
R159	Composition, 62 kΩ ±5% 1/2 W	6100-3625	01121	RC20GF623J	5905-702-5971
R160	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-686-3373
R161	Film, 18.2 kΩ ±1% 1/8 W	6250-2182	75042	CEA, 18.2 kΩ ±1%	
R162	Film, 2.52 kΩ ±1/2% 1/8 W	6251-1252	75042	CEA-TO, 2.52 kΩ ±1/2%	
R163	Film, 1.27 kΩ ±1% 1/8 W	6250-1127	75042	CEA, 1.27 kΩ ±1%	5905-721-0281
R164	Composition, 62 kΩ ±5% 1/2 W	6100-3625	01121	RC20GF623J	5905-249-3656
R165	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-702-5971
R166	Film, 18.2 kΩ ±1% 1/8 W	6250-2182	75042	CEA, 18.2 kΩ ±1%	5905-686-3373
R167	Composition, 360 Ω ±5% 1/2 W	6100-1365	01121	RC20GF361J	5905-279-1889
R168	Composition, 300 kΩ ±5% 1/2 W	6100-4305	01121	RC20GF304J	5905-185-6859
R169	Potentiometer, 5 kΩ ±10%	6048-2509	01121	JB, 5 kΩ ±10%	
R170	Film, 1.4 kΩ ±1% 1/8 W	6250-1140	75042	CEA, 1.4 kΩ ±1%	

PARTS LIST (cont.)

Ref. Desig.	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
R171	Composition, 15 kΩ ±5% 1/2 W	6100-3155	01121	RC20GF153J	5905-279-2616
R172	Composition, 4.3 kΩ ±5% 1/2 W	6100-2435	01121	RC20GF432J	5905-257-0935
R173	Composition, 9.1 kΩ ±5% 1/2 W	6100-2915	01121	RC20GF912J	5905-249-4200
R174	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-702-5971
R175	Film, 18.2 kΩ ±1% 1/8 W	6250-2182	75042	CEA, 18.2 kΩ ±1%	5905-686-3373
R176	Film, 2.52 kΩ ±1/2% 1/8 W	6251-1252	75042	CEA-TO, 2.52 kΩ ±1/2%	
R177	Composition, 15 kΩ ±5% 1/2 W	6100-3155	01121	RC20GF153J	5905-279-2616
R178	Composition, 4.7 kΩ ±5% 1/2 W	6100-2475	01121	RC20GF472J	5905-279-3504
R179	Film, 18.2 kΩ ±1% 1/8 W	6250-2182	75042	CEA, 18.2 kΩ ±1%	5905-686-3373
R180	Composition, 62 kΩ ±5% 1/2 W	6100-3625	01121	RC20GF623J	5905-249-3656
R181	Composition, 3.9 kΩ ±5% 1/2 W	6100-2395	01121	RC20GF392J	5905-279-3505
R182	Film, 20 kΩ ±1% 1/8 W	6250-2200	75042	CEA, 20 kΩ ±1%	5905-702-5971
R183	Composition, 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R184	Composition, 16 kΩ ±5% 1/2 W	6100-3165	01121	RC20GF163J	5905-279-3501
R185	Composition, 4.3 kΩ ±5% 1/2 W	6100-2435	01121	RC20GF432J	5905-257-0935
R186	Composition, 16 kΩ ±5% 1/2 W	6100-3165	01121	RC20GF163J	5905-279-3501
R187	Film, 1 kΩ ±1% 1/8 W	6250-1100	75042	CEA, 1 kΩ ±1%	5905-581-6915
R188	Composition, 5.1 kΩ ±5% 1/2 W	6100-2515	01121	RC20GF512J	5905-279-2019
R189	Composition, 6.2 kΩ ±5% 1/2 W	6100-2625	01121	RC20GF622J	5905-279-2673
R190	Composition, 1 MΩ ±5% 1/2 W	6100-5105	01121	RC20GF105J	5905-192-0390
R191	Film, 5.11 kΩ ±1% 1/8 W	6250-1511	75042	CEA, 5.11 kΩ ±1%	5905-577-6734
R192	Wire Wound, 7.9 kΩ +1-0%	6981-4009	24655	6981-4009	
R193	Composition, 680 Ω ±5% 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R194	Wire Wound, 4 kΩ +1-0%	6981-4008	24655	6981-4008	
R195	Composition, 2.2 kΩ ±5% 1/2 W	6100-2225	01121	RC20GF222J	5905-279-1876
R196	Film, 5.49 kΩ ±1% 1/8 W	6250-1549	75042	CEA, 5.49 kΩ ±1%	
R197	Composition, 1 MΩ ±5% 1/2 W	6100-5105	01121	RC20GF105J	5905-192-0390
R198	Film, 825 Ω ±1% 1/8 W	6250-0825	75042	CEA, 825 Ω ±1%	5905-702-4172
R200	Film, 100 kΩ ±1% 1/8 W	6250-3100	75042	CEA, 100 kΩ ±1%	5905-577-6743
R201	Film, 100 kΩ ±1% 1/8 W	6250-3100	75042	CEA, 100 kΩ ±1%	5905-577-6743
R202	Potentiometer, 25 kΩ ±20%	6040-0800	01121	PWC, 25 kΩ ±20%	5905-958-7950
R203	Film, 15 kΩ ±1% 1/8 W	6250-2150	75042	CEA, 15 kΩ ±1%	5905-581-7626
R204	Potentiometer, 1 kΩ ±5%	6058-2105	75042	CT-100, 1 kΩ ±5%	
R205	Film, 82.5 kΩ ±1% 1/8 W	6250-2825	75042	CEA, 82.5 kΩ ±1%	5905-883-4846
R206	Potentiometer, 10 k ±1%	0971-4270	24655	0971-4270	
R207	Film, 2.43 kΩ ±1% 1/8 W	6250-1243	75042	CEA, 2.43 kΩ ±1%	5905-577-1685
R501	Composition, 470 Ω ±5% 1 W	6110-1475	01121	RC32GF471J	5905-299-2051
R502	Composition, 1.2 kΩ ±5% 1/2 W	6100-2125	01121	RC20GF122J	5905-190-8880
R503	Composition, 7.5 kΩ ±5% 1/2 W	6100-2755	01121	RC20GF752J	5905-249-4195
R504	Composition, 4.7 kΩ ±5% 1/2 W	6100-2475	01121	RC20GF472J	5905-279-3504
R505	Composition, 4.7 kΩ ±5% 1/2 W	6100-2475	01121	RC20GF472J	5905-279-3504
R506	Composition, 5.6 kΩ ±5% 1/2 W	6100-2565	01121	RC20GF562J	5905-195-6453
R507	Composition, 3.3 kΩ ±5% 1/2 W	6100-2335	01121	RC20GF332J	5905-279-3506
R508	Potentiometer, 5 kΩ ±10%	6050-1700	12697	43WX, 5 kΩ ±10%	5905-794-3859
R509	Composition, 8.2 kΩ ±5% 1/2 W	6100-2825	01121	RC20GF822J	5905-299-1971
R510	Power, 1.8 kΩ ±5% 10 W	6670-2185	01636	10XM, 1.8 kΩ ±5%	
R511	Film, 294 kΩ ±1% 1/8 W	6250-3294	75042	CEA, 294 kΩ ±1%	5905-892-0092
TRANSISTORS					
Q101	Type C6601A	8210-1082	94589	D3068A	
Q102	Type 2N3391A	8210-1092	24454	2N3391A	
Q103	Type 2N3391A*	8210-1083	24454	4JX16A733	
Q105	Type 2N3415	8210-1103	24454	2N3415	
Q106	Type 2N3391A	8210-1092	24454	2N3391A	
Q107	Type 2N3391A	8210-1092	24454	2N3391A	
Q108	Type 2N3905	8210-1114	04713	2N3905	
Q109	Type 2N3415	8210-1103	24454	2N3415	
Q110	Type 2N3391A	8210-1092	24454	2N3391A	
Q111	Type 2N3391A	8210-1092	24454	2N3391A	
Q112	Type 2N3391A	8210-1092	24454	2N3391A	
Q113	Type 2N3391A	8210-1092	24454	2N3391A	
Q114	Type 2N3391A	8210-1092	24454	2N3391A	
Q115	Type 2N3391A	8210-1092	24454	2N3391A	
Q116	Type 2N3391A	8210-1092	24454	2N3391A	
Q117	Type 2N2189	8210-1056	01295	2N2189	
Q118	Type 2N2189	8210-1056	01295	2N2189	
Q501	Type 2N1131	8210-1025	96214	2N1131	5960-788-8644

PARTS LIST

Ref. Desig.	Description	GR Part No.
Q502	Type 2N2349	8210-1021
Q503	Type 2N2349	8210-1021
DIODES		
CR101	Type 1N191	6082-1008
CR102	Type 1N191	6082-1008
CR103	Type 1N191	6082-1008
CR104	Type 1N191	6082-1008
CR201	Type 1N645	6082-1016
CR202	Type 1N645	6082-1016
CR301	Type 1N645	6082-1016
CR302	Type 1N645	6082-1016
CR303	Type 1N645	6081-1001
CR501	Type 1N3253	6081-1001
CR502	Type 1N3253	6081-1001
CR503	Type 1N645	6081-1001
CR504	Type 1N3254	6083-1014
CR505	Type 1N759A	6083-1014
JACKS		
J101	Jack	4260-1031
J102	Jack	4260-1041
J103	Jack	4260-1031
J104	Jack	4260-1031
S101		
SWITCHES		
S101	Switch	7890-4...
S102	Switch	7890-4940
S103	Switch	7910-0500
S104	Switch	7890-4290
S501	Switch	7890-4250
S502	Switch	7910-0831
BATTERIES		
B101	Battery, 2BA-1040	8410-1040
B102	Battery, 2BA-1040	8410-1040
SOCKETS		
SO101	Socket, Connector, multiple	4200-2840
SO102	Socket, Socket Asm.	4200-2850
OTHER PARTS		
M101	Meter, ME-3 TYPE	5730-1395
PL501	Power Plug	4240-0300
P501	Indicator Lamp, 6 V	5600-0300
F501	Fuse, Sto Blo, 0.1 Amp	5330-0400
T501	Transformer, Power	0745-4390

*Selected for max NF = 3 dB

PARTS LIST (cont.)

Ref. Desig.	Description	GR Part No.	FMC	Mfg. Part No.	Fed. Stock No.
Q502	Type 2N2349	8210-1021	01295	2N2349	5961-967-1343
Q503	Type 2N2349	8210-1021	01295	2N2349	5961-967-1343
DIODES					
CR101	Type 1N191	6082-1008	93916	1N191	5961-296-3360
CR102	Type 1N191	6082-1008	93916	1N191	5961-296-3360
CR103	Type 1N191	6082-1008	93916	1N191	5961-296-3360
CR104	Type 1N191	6082-1008	93916	1N191	5961-296-3360
CR201	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR202	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR301	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR302	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR303	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR501	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR502	Type 1N3253	6081-1001	79089	1N3253	5961-814-4251
CR503	Type 1N645	6082-1016	24446	1N645	5961-944-8222
CR504	Type 1N3254	6081-1002	09213	1N3254	5961-082-3988
CR505	Type 1N759A	6083-1014	81349	1N759A	5961-846-9157
JACKS					
J101	Jack	4260-1031	82389	N111	
J102	Jack	4260-1041	82389	N112A	
J103	Jack	4260-1031	82389	N111	
J104	Jack	4260-1031	82389	N111	
S101					
SWITCHES					
S101	Switch	7890-4290	24655	7890-4290	
S102	Switch	7890-4940	24655	7890-4940	
S103	Switch	7910-0800	04009	83052-SA	
S104	Switch	7890-4290	24655	7890-4290	
S501	Switch	7890-4250	24655	7890-4250	
S502	Switch	7910-0831	42190	4603	
BATTERIES					
B101	Battery, 2BA-1040	8410-1040	09823	CD25	
B102	Battery, 2BA-1040	8410-1040	09823	CD25	
SOCKETS					
SO101	Socket, Connector, multiple	4230-2840	24655	4230-2840	
SO102	Socket, Socket Asm.	4230-2850	24655	4230-2850	
OTHER PARTS					
M101	Meter, ME-3 TYPE	5730-1395	40931	Meds-1395	
PL501	Power Plug	4240-0600	24655	4240-0600	5935-816-0254
P501	Indicator Lamp, 6 V	5600-0300	24454	#328	6240-155-7857
F501	Fuse, Sto Blo, 0.1 Amp	5330-0400	71400	MDL, 0.1 Amp.	5920-356-2185
T501	Tramsformer, Power	0745-4390	24655	0745-4390	

*Selected for max NF = 3 dB

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